JUNE 1970 60 CENTS

Popular Science

THE *What's New* MAGAZINE

The '71 CARS

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New Multi-Screen Set Lets You Switch to Where the Action Is!

THE WINNERS of the $25,000 Anti-Car-Theft Competition

How the "New" LEAD-FREE GASOLINES Will Affect Your Car's Engine

FACTORY-BUILT HOUSES Will Cost You Less and Give You More

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- Far-Out Station-Wagon Camper
- Trailer-Hitching Guide

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1970, The Gillette Co., Boston, Mass.

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THE *What's New* MAGAZINE™

JUNE 1970 Founded in 1872/Vol. 196, No. 6

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How the change to lead-free gasoline will affect you and your car's engine.

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With this wild new television set, you could watch four shows at once—and switch to where the action is!

What's Coming in '71 Cars PAGE 50
Our Detroit operative, Jim Dunne, lifts the veil on next fall's models.

Factory-Built Houses—Cheaper and Better? PAGE 52
Modular construction may be the answer to our critical housing shortage.

Ingenious Undersea Tools By SCOTT CARPENTER PAGE 56
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COVER PAINTING BY DON CROWLEY

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EDITORIAL OFFICES:
355 Lexington Ave., New York, N. Y. 10017

PUBLISHED MONTHLY By Popular Science Publishing Co., Inc., 355 Lexington Ave., New York, N. Y. 10017.

SUBSCRIPTION SERVICE

New or Renewal Orders: Send to: Popular Science Subscription Department, Boulder, Colorado 80302. One year $5, 2 years $9, 3 years $12 in U.S. and its possessions. One year $6, 2 years $11, 3 years $15 in Canada. Elsewhere, 1 year $8.50, 2 years $16, 3 years $23. Single Copy 50¢ in U.S. and 60¢ in Canada & elsewhere. *Subscription orders processed electronically* ● ***All subscription adjustments:*** Write to Robert Harlan, Popular Science, P.O. Box 1083, Boulder, Colo. 80302. For change of address allow six weeks; please give both old and new addresses. Notices of undelivered copies (Form 3579) to Mr. Harlan. ● Second class postage paid at New York, N.Y., and at additional mailing offices. Entered as second class matter at the Post Office Department, Canada. Printed in U.S.A.

ADVERTISING OFFICES

NEW YORK: 355 Lexington Ave. (10017), Tel. 212-687-3000; CHICAGO: 401 N. Michigan Ave. (60611), Tel. 312-527-0550; DETROIT: 1716 Fisher Building (48202), Tel. 313-872-7060; LOS ANGELES (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005), Tel. 213-380-1936.

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What's New
NEXT MONTH

What's Happening with the SST?
You could be flying in a supersonic transport sooner than you think. And it may not be labeled "made in U.S.A."

Norbye/Dunne Report: Deluxe Sporty Compacts
Our talented team of testers checks out three hot ones: the Firebird, the Cougar, and the Challenger

How Science Can Foil the Plane Hijackers
A remarkable electronic device may be the answer to a growing hazard of air travel

The Great Space Shuttle Race
Space-expert Wernher von Braun describes the rival concepts for a craft that will whisk 50 passengers into space—and bring them back to earth for a plane-like landing

10,000 Miles in a Gremlin
PS West Coast Editor Jim Davis brings you an in-depth report on American Motors' mini-compact—first of a brand-new breed of U.S. automobiles

You Can Drive a Pollution-Free Car Now
Convert to LPG . . . liquid-petroleum gas gives clean exhaust without loss of performance, and conversion is quick and simple

Turn Bowls on a Tablesaw?
Yup. R. J. De Cristoforo, PS Consulting Editor on Tools & Techniques, shows you how

Les Walker's Wonderful Table/Rocker
For 4-in-1 patio fun, build this versatile plywood structure. It's a rocker . . . it's a picnic table . . . it's a playpen . . . it's a bar!

PLUS:
Many more feature articles, all the regular PS departments—and a big What's New section to keep you up-to-the-minute in boating, electronics, photography, tools, what's new for your car, your home, shop, and yard

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Catering & Banquet Manager

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Restaurant Manager

Airline Food Supervisor

The booming Restaurant/Club field needs thousands of new managers. Read how you can qualify with spare-time training.

Here's your big chance to step up to man-sized earnings and executive status in one of the nation's largest industries.

America's exciting Restaurant/Club and Food Service industry has grown so big and fast it needs 50,000 more managers to help "run the show." At salaries of $10,000, $12,000, $15,000 a year. And even more!

Food and beverage managers are professionals who enjoy prestigious careers that others envy. In restaurants and smart country clubs. In hotels and resorts. In big college and company cafeterias. At airports and on cruiseships. And in all the other places where millions eat away from home. Now *you* can take the step that will get you into this lucrative field with both feet!

Now—authorized "at-home" training for you

Because there just aren't enough trained people around to fill all the new executive openings each year, the Restaurant/Club industry opens its doors wide to newcomers willing to train. The Educational Institute of the American Hotel & Motel Association is now offering its executive training courses to you through LaSalle, famed leader in correspondence study. You learn in your spare time at home without a day lost from your present job.

These are the same courses endorsed by top officials of such famous chains as Howard Johnson's, Hilton, Sheraton, Marriott, Ramada and many others.

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Mail the coupon today for free illustrated booklet "Rewarding Careers in Restaurant/Club & Food Management." LaSalle, 417 S. Dearborn Street, Chicago, Illinois 60605.

Robert D. Parks, Executive Vice President of Operations for Howard Johnson's, says: "The industry's need for supervisory and executive personnel is huge and growing. To help meet this need, I heartily recommend the excellent Food & Beverage Management Courses of the AH&MA's Educational Institute."

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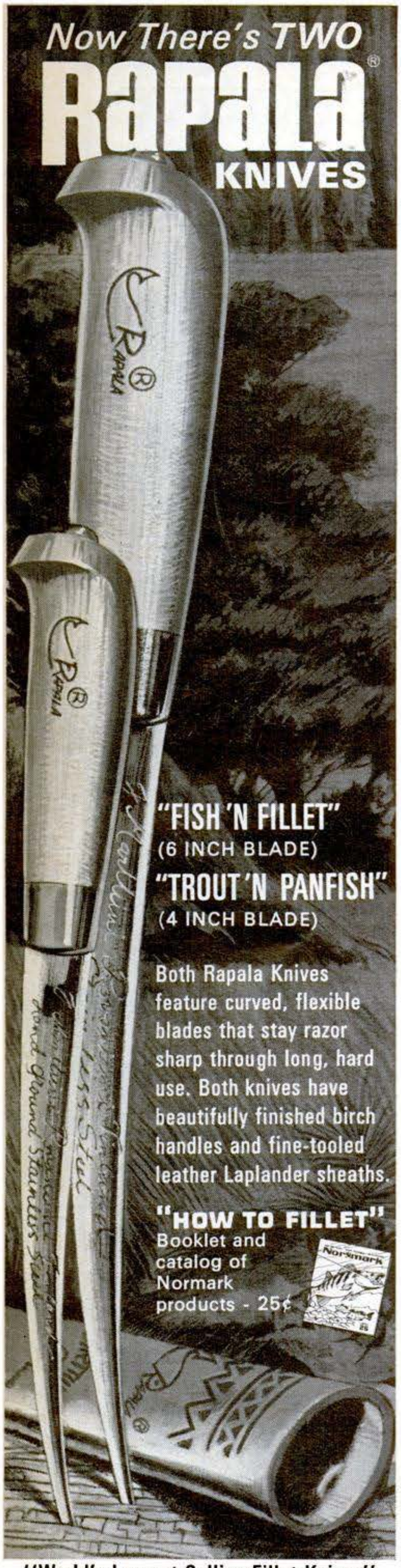

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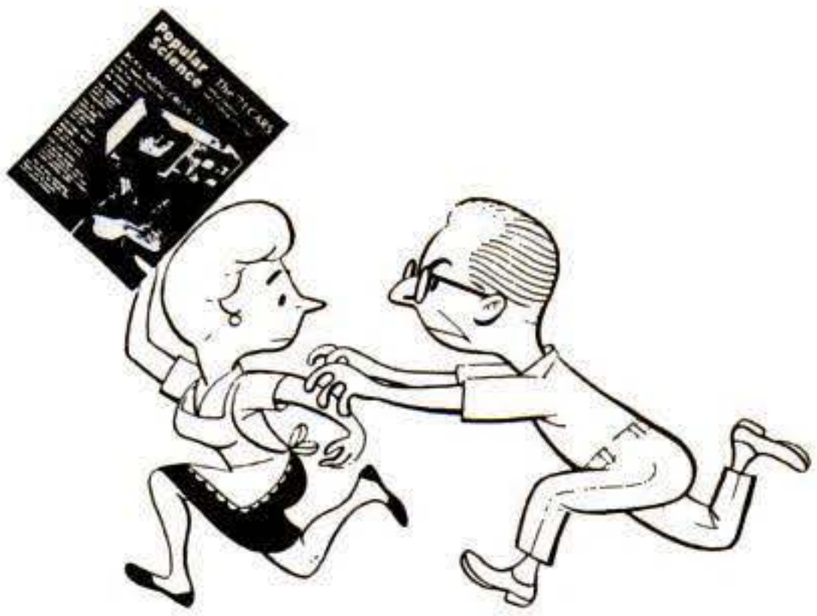

Where you voice your views . . . and the editors do the listening

Wankel: Ask the man who owns one

Fritz Baur ["PS Readers Talk Back, Apr.] should read his back copies to learn more about the Wankel engine. He says the Wankel is uneconomical. PS reports 25 mpg for the NSU Spider. Oil consumption is no greater (from personal experience of driving one for five years) than for a reciprocating piston engine.

Baur also says the Wankel is short-lived. PS reports show that the side plates failed after 1,000 hours of operation at full speed. The tachometer on my Spider goes as high as 8,000 rpm. At 100 mph, the tach registers 6,000 rpm. Ergo, the side plates fail at about 133,000 miles—if the engine is operated at full speed at all times.

What about Baur's charges of noise, thermal, and air pollution caused by the Wankel? Our new silent spy plane, the Lockheed Q-Star, is powered by a Wankel. And I'll challenge him to measure noise from an 8,000-rpm piston vs. a Wankel. The NSU Spider also meets pollution standards, which is required for an import license.

I am also reminded of the PS reader who, after the first story on the NSU Spider, wrote that he would "wave goodbye to the purchaser of the $3,000 Spider from the seat of his $2,000, six-cylinder Detroit car. You might tell him I'm still looking for a $2,000, six-cylinder Detroit car.

CHARLES B. WARREN, Richmond, Calif.

That saucy sauna

After reading the letters about the nude photo in a "Sauna for Your Home" ["PS Readers Talk Back," Apr.], I'd like to say that it was done in very good taste. This is what I would expect to find in a sauna. You have always done a good job and in good taste. Keep up the good work.

ANDREW FREY, Dayton, Ohio

. . . I hope you do not intend to use the editorial comment that POPULAR SCIENCE is written and edited for the adult male as a lame excuse for printing more nude photos.

JONATHON D. HEIN, Lansing, Mich.

. . . I thought the picture was fine. It added a little spice to the article. Anyone who thought it was dirty must be a prude.

R. BLACKMAN, Toronto, Ont.

. . . I was disturbed by the comment that your articles are "written and edited for the adult male." As an adult female subscriber, I am offended at this discrimination. It seems to me that POPULAR SCIENCE should be written and edited for women and men who are interested in science, technology, and the general contents of the magazine. It is unethical and possibly illegal for a national magazine to discriminate against women.

BARBARA SAKITT, Ph.D., Berkeley, Calif.

No offense intended. Our target readership is the adult male, but everyone is welcome to our family of readers.

The Norbye/Dunne tests

You must be jesting in "The Deluxe Wagons" [Mar.] report. It leads one to believe you are employed by GM. I leased a Buick station wagon in 1968, and the results were disastrous.

RICK BRYAN, Cincinnati, Ohio

Who is jesting? You could not have leased the full-size wagon we tested—it just came on the market this year.

. . . Heating ducts should be built into the floor, piping heat to the rear seat. This would allow the driver and rear-seat passengers both to be comfortable. Think of all the small children who ride in back seats of station wagons without the driver realizing how chilly they are. Of all the tests I've read, I have never seen this point given any attention.

ARNOLD BURKETT, Weedville, Pa.

. . . I have noticed that in recent Norbye/Dunne reports they seem to be pushing American Motors. Is Rambler paying you, or what?

R. W. GORMAN, Baltimore, Md.

We only give you the facts, sir, as they are developed by our tests. We don't care what nameplate is on the car.

. . . Your automotive reports are unequaled in their excellence. Norbye and Dunne should be lauded for their straightforward, comprehensive, and unbiased automotive tests. They rightly omit frivolous comment and stick to the facts so that the reader can then form his own opinions.

G. L. MCCUTCHEON, Webb AFB, Tex.

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1.
10-inch-longer useable loadspace.

2.
Independent front suspension and 3½-inch-longer wheelbase for better ride and handling.

3.
345 pounds more payload. Up to 3930 pounds on Tradesman 300.

4.
Hidden cargo step. Cargo doors easier to open. Won't stick or collect ice or snow.

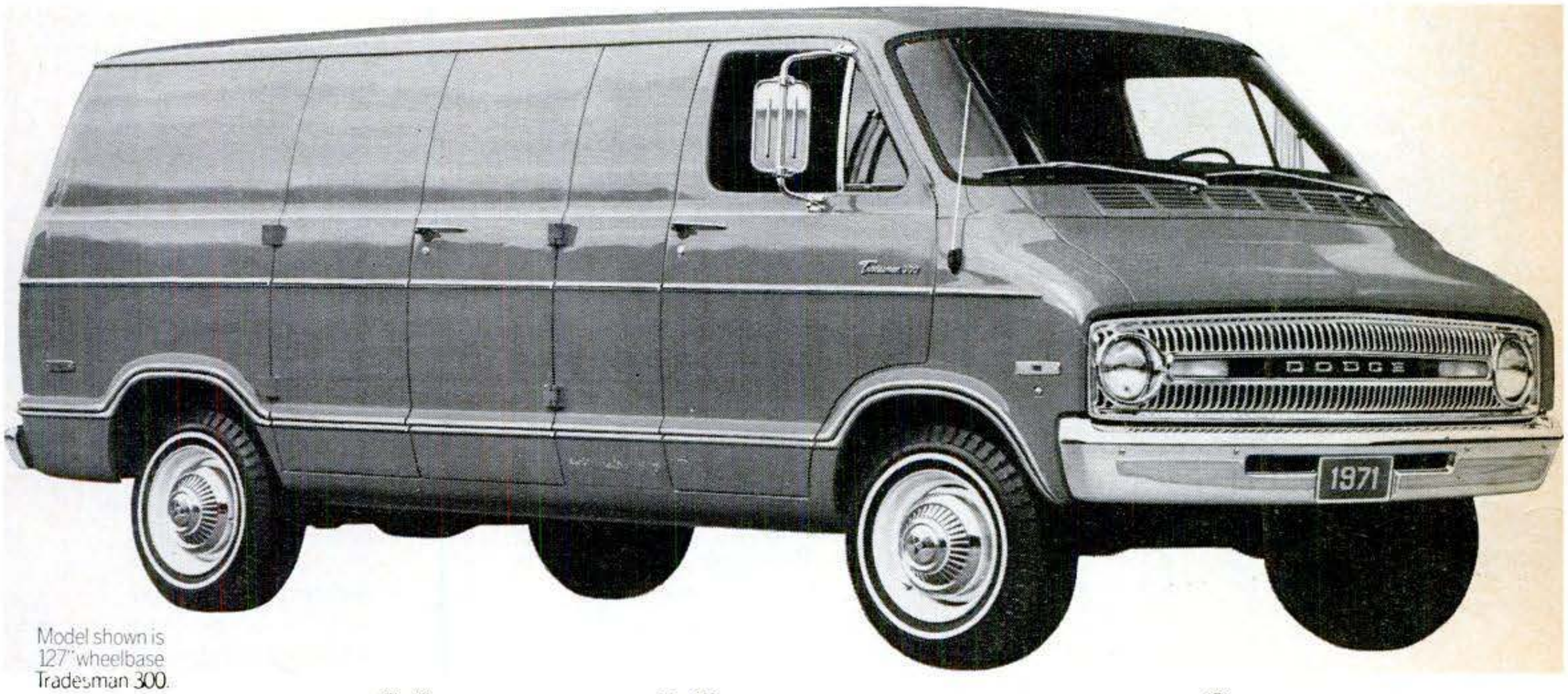
5. 6.
Power steering, optional. Power brakes, optional.

7.
7-inch-larger hood opening. Easier battery, dipstick, and radiator servicing.

8.
Engine cover is 4 inches lower, 10 inches shorter. Makes it easy for driver to reach cargo area.

9.
Integral air conditioning, optional.

10.
Car-style instrument panel. All controls within easy reach



Model shown is 127" wheelbase Tradesman 300.

11.
Bumper jack can be used with full load on Tradesman 100 and 200.

12 13
Engine can be removed quickly and easily through front of truck
Wider doors and door steps and less wheelhouse intrusion make for easier ins and outs.

14 15
Two-stage door checks stop front doors from accidentally closing on you.
Posi-latch doors won't spring open.

16
Automatic transmission, optional with all Tradesman models.

17
Independent suspension and standard track allow independent front wheel alignment on passenger car equipment

18
Bigger standard engines. 198 Six, 318 V8.

INTRODUCING THE ALL-NEW 1971 DODGE STRONG BOX

The big, new Tradesman Van that outdoes the better idea people 31 ways.

19.
26-gallon gas tank.

20 21
Two-inch-wider seats with square corners for better leg support
Full-foam padding means softer ride, more comfort.

22 23
Full-width sun visors. Larger windshield wiper pattern.

25
Extra rust protection for underside and rocker panels.

27 28
Wind tunnel body shape and 60" radius windows reduce wind sway effect.
Doors adjustable three ways for better sealing.

24
Front seat does not block the cargo door entrance.

26
High-level air intake keeps incoming air cooler and cleaner.

29 30 31
Fiber-glass engine cover reduces interior heat and noise
Ashtray on engine cover. Easy to reach
Heater located in engine compartment for more leg- and footroom.

Dodge Trucks

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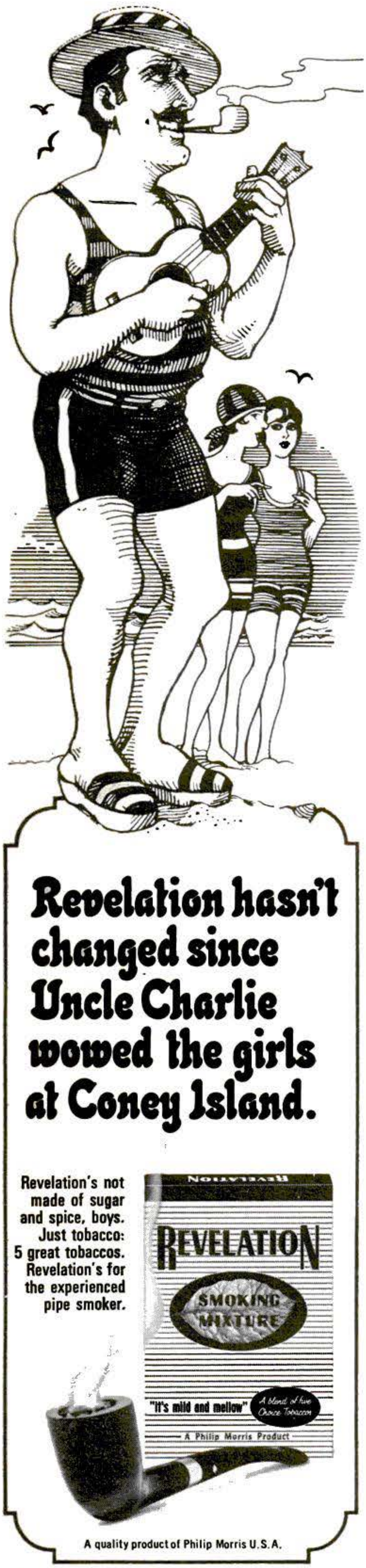

. . . I must compliment you on your informative automobile reports. And I was pleased when recently you introduced sound-level measurements.

But your interpretations of the A, B, and C settings of the meter are seriously in error. They do not, as you suggest, enable measurements to be made in different frequency bands; rather, each of them measures sound at all audible frequencies but with different weightings or frequency responses.

I would suggest that A- and C-weighted measurements are all that are required, and that you might revise your erroneous and somewhat optimistic interpretations of the significance of the measurements.

F. E. TOOLE,
Ottawa, Ont.

We went overboard in our efforts to simplify the explanation of the test. But the analyses are accurate because we have been able to establish the frequency of the noise sources on a basis of the db differentials.

Interesting, but is it safe?

The cassette-tape storage rack shown in the March Wordless Workshop is

very interesting. If you built this rack and placed it between the speakers as shown above, would there not be damage to the recordings?

R. H. REIBER JR., Dover, Mass.

Sound waves, of course, do not affect tape. The only possible damaging effect might be from the magnetic field of the speaker magnet. The risk is more theoretical than real in this instance.

High-octane remarks

Thank you for publishing "Why They Should Tell You the Octane Rating of the Gasoline You Buy" [Apr.] by Ralph Nader. I found it informative and objective. I'd like to see you make him a regular contributor.

ROGER PANEK, Mill Valley, Calif.

. . . Ralph Nader was somewhat misleading. The oil industry labels its grades of gasolines over a range of octanes, and varies this range through the seasons and localities for a very good reason. An engine requires different grades of gasoline under different conditions. Octane requirements are greater in hot weather, stop-and-go driving, hilly terrain, or racing, than in cold weather or turnpike driving. The difference is often quite large. A driver would be defeating his own purpose if he insisted on always using the exact octane, regardless of driving conditions. Nader made one very good point and should have stuck with it: The oil industry should be required to list the octane rating of its gasolines.

ARTHUR TENNER, Ithaca, N.Y.

All mixed up

Methinks Smokey really pulled a boo-boo [Apr.] telling Helen Smith "I would first put the two radials on the front" when he okayed mixing of regular and radial tires. My reading and experience say this is a no-no. Does Smokey have fact and proof up his sleeve that the tire manufacturers, researchers, and safety experts know nothing about, or did he really go out on a limb and lose Brownie points? If he really did goof, congratulations and welcome to the human race, Smokey.

GUY E. TIMMONS
East Lansing, Mich.

Michelin agrees with your experience that the radials should go on the rear wheels when mixed with regular tires.

Hot or cold air for your gas?

In "Pep Up Your Car With Cold Air" [Mar.], Clyde J. Baker says that you get better mileage by inducting cold air. In "Tricks You Can Use to Save Gas" [Apr.] Jan P. Norbye says that you should preheat air before it enters the engine. What *do* you do?

DAN CASWELL, Barney, N.D.

. . . Your advice about preheating the intake air is in direct conflict with present car-manufacturers' claims about ram air induction, or cooler, heavier air for great power. Which is best?

R. L. NORTH, Indianapolis, Ind.

Warm air gives you better mileage. You misread Mr. Baker. He said you get more power with cold air. Hot air gives better mileage but less power.

. . . A word of caution should you try to pep up your car with cold air—if you live in the snow belt. Trying to

start your engine without first clearing the cowl grille of snow will result in an overchoked condition. This will prevent engine start, or cause a flooding gasoline stall in short order if it does start—more so during a hail storm, since the hail goes through grille and screen. A clogged grille also causes a heater blower motor to overheat.

ROBERT ADAMS, Williston Park, N.Y.

Want to get something off your chest?
Write "Readers Talk Back,"
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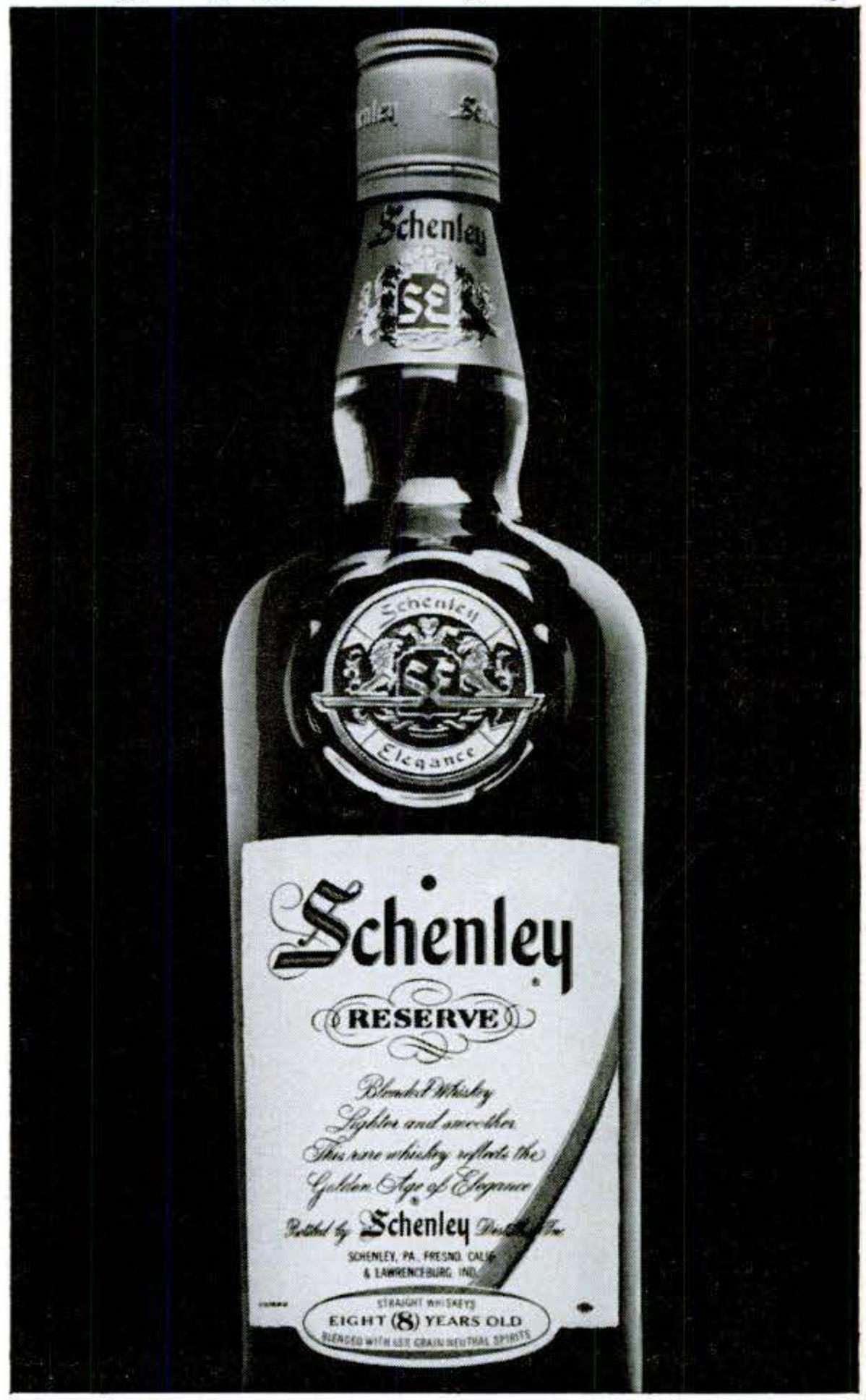
8 years ago

American women exposed their knees!

We began aging the whiskeys for today's Schenley.*



For most people 1962 is just a memory. But for whiskey drinkers it's an important year.

That's when the vigil over the whiskeys for this year's blend began.

We let them mellow for eight long years (the only leading blend that does). Eight long years that lighten-them-up and cool-them-out. Schenley Reserve. Mixed or straight.

When you taste it you'll be glad 1970 started in 1962.

*Blended Whiskey • Eight Year Old Straight Whiskeys (35%) • Grain Neutral Spirits (65%) • 86 Proof © Schenley Distillers Co., N.Y.C.

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But this one thinks Lifesaver Radials are too good not to be talked about.

This trooper is masked, and his uniform disguised, because neither he nor his state can lend their names to any commercial product.

This man's life depends upon his tires. He puts over 50,000 high-speed miles a year on them.

He's concerned with highway safety. And because he knows your life depends upon your tires, he agreed to give his expert testimony.

"I was off to the side when this guy raced past me. I floored it to catch up. And there I was going into a double curve—we call it Deadman's Curve—at 115 miles an hour. But I never swerved out of my lane. It was like riding a rail.

"After that, I'm getting a set of these radials for my own car. I have good reasons...my wife and kids."

You can hear the same kind of stories from troopers across the country riding on B. F. Goodrich radials. The same tires you can buy. Of course, you'll seldom need the maximum performance troopers need, even for short periods of time. But it's nice to know these tires can deliver it.

We call the newest BFG radials *Lifesavers*. With good reason. Lifesavers corner better. Take curves better. Stop quicker. They handle better at high speed than any fiberglass-belted tire... even our own.

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The radial construction of Lifesavers is unique. The sidewalls flex, keeping all the tread on the road all the time. And the Dynacor Rayon belt stabilizes the tread for extra strength and mileage. 33% stronger than fiberglass tires. 40,000 miles or more on a set.

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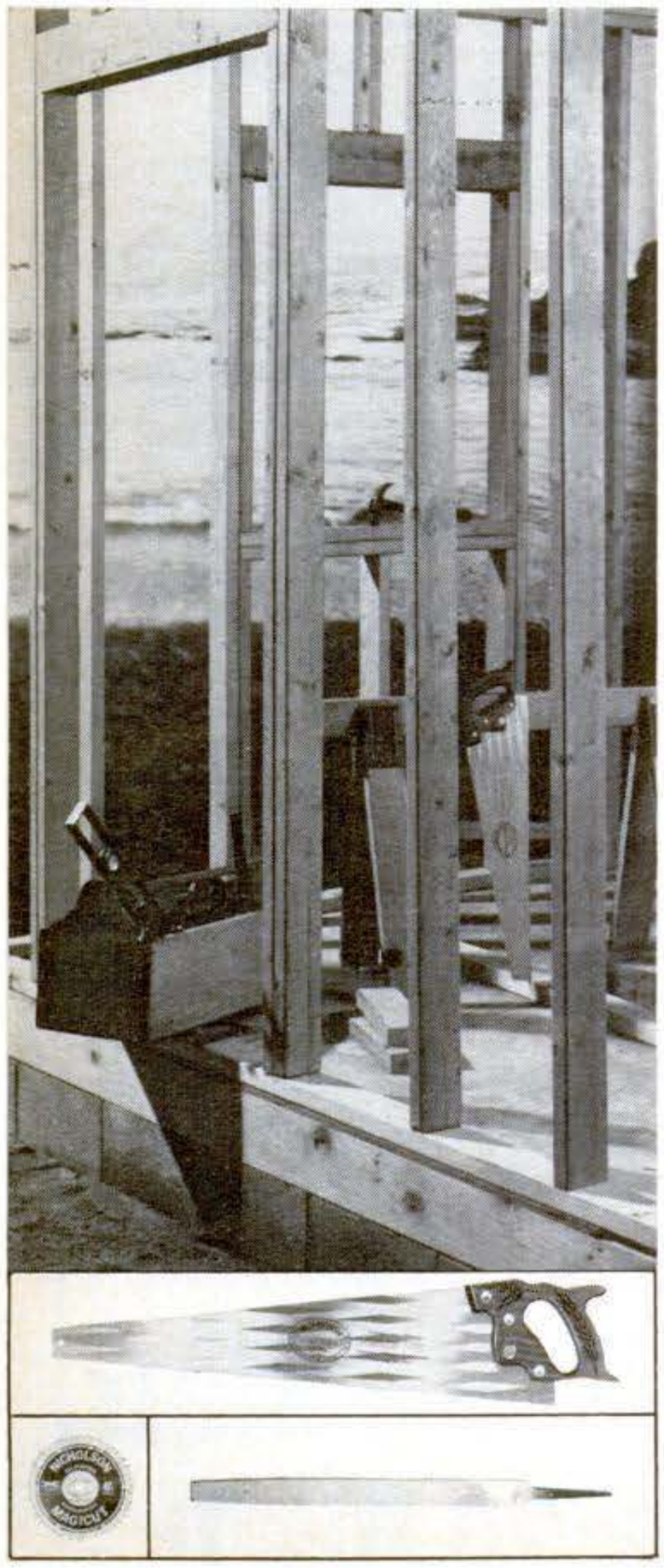

Detroit Report...

AN ALL-NEW, FOUR-WHEEL-DRIVE CORVETTE will probably be introduced by Chevrolet within 18 months. One prototype now in accelerated testing has a 400-cu.-in. V8 mounted crosswise in midship position. Suspension is independent on all four wheels; rear coil springs replace the transverse leaf. In April, Chevrolet's John DeLorean denied plans for a midship 'Vette, but announcements from American Motors (AMX/3) and Lincoln-Mercury (Pantera) could change this.

Chevy's small car will not have a GT version until months after the bread-and-butter models are unveiled. The GT will have a 150-hp engine built on the same aluminum block to be used in the coupe, sedan, station wagon, and panel-truck models of the XP-887. Featuring bucket seats, rally suspension, special grille, and an overall sportier appearance, the GT will compete with the imported sport cars in the $3,000 to $3,500 price range. Look for this car to be a 1971½ model next winter.

Chrysler's decision to build its 1971 intermediate models in two wheelbases à la General Motors will be followed by Ford's '72 intermediates. The intermediate Plymouth and Dodge, now called Belvedere and Coronet, will share two wheelbases, 115 inches for two-door hardtops, 117.5 inches for sedans and station wagons. Front and rear overhang make the Dodges about four inches longer than the Plymouths. Ford's Torino and Montego intermediates will also change to frame-and-body construction for the first time. Ford has long wanted to get away from the unit-body construction for these models, but 1972—a major changeover year—is the earliest the design could be scheduled.

Two major safety features that will be required in future cars are provided for in many of the 1971 models. Ford has made room in the instrument panel of some '71 cars to house an air-bag restraint system. Reports continue to circulate that Mercury will have air bags on a number of '71 full-size cars as part of a fleet testing program. Side-impact protection beams will show up for the first time in some 1971 Ford cars. Ford's beams will be made of U-shaped steel bars that are lighter than GM's guard-rail design.

Pontiac and Oldsmobile are anxious to get into the small-car race, but General Motors' corporate policy is working against them. Traditionally these divisions must have more expensive models than Chevrolet. The two divisions are trying to come up with a lower-volume small car that will sell for more than Chevrolet's, but will offer something different. Olds has proposed a two-seater sports car of the XP-887's dimensions, but more powerful and more luxurious. Pontiac has also been looking at the two-seater, but would prefer a slightly higher-priced sedan.

Ford is not sure that ventless door windows are a good thing. Many drivers, especially smokers, complain about the lack of air circulation in the cars with single-paned door glass. All cars come in for criticism here. Ford engineers are now working to put the vent wing back in the door, but with a modern design to use only one window crank for opening both vent and door glass.

You don't need a sharp eye to see a whole lot of Fiat in Chevrolet's new small car. And this is no accident. The body of the two-door sedan is a near ringer for the 124 sport coupe, and prototypes are even painted the light brown color Fiat made popular. In developing the chassis for the new car, Chevrolet and Fisher Body did extensive testing of the 124 sedan—evidenced by the dissected bodies in Fisher's scrap pile. Earlier this year John DeLorean, Chevy chief, cited the Fiat 124 sport coupe in describing the GT model the division is preparing. Chevy could do a lot worse. The 124 is considered by many to be among the best 10 cars in the world.

Car-body experts have been talking about a modular car for years, and it looks as if Detroit is already working toward that goal. The modular car is built in sections which can be interchanged between models in one line, or between different types of cars. The closest thing we now have to modular design is at American Motors, where Javelin and AMX, Hornet and Gremlin share complete body sections. The sport cars are essentially the same from the B post forward. Ditto for Hornet and Gremlin. Look for the big auto makers to use the same approach in building two-seat sport cars from the Mustang and Camaros. True modular cars are slightly different in concept, but will offer the same versatility of design AM now has in its small models.

Jim Dunne

Detroit Editor

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The winning team lines up behind Champion spark plugs.

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ı make a difference.

Hockey great Phil Esposito
s and basketball star Bailey Howell
ı proved it in an acceleration test.

They chose up sides and led
t their teams in two relay races.
l Each team had a Buick,
s a Chevrolet, a Pontiac and an
) Oldsmobile. Both teams were perfectly matched, with one exception. The cars in Esposito's team were powered by Champion TurboAction design spark plugs, while Howell's team used a competitive brand of different design.

The result? Phil's team won with Champions. When the teams swapped plugs and ran the relay again, Bailey's team won . . . with Champions.

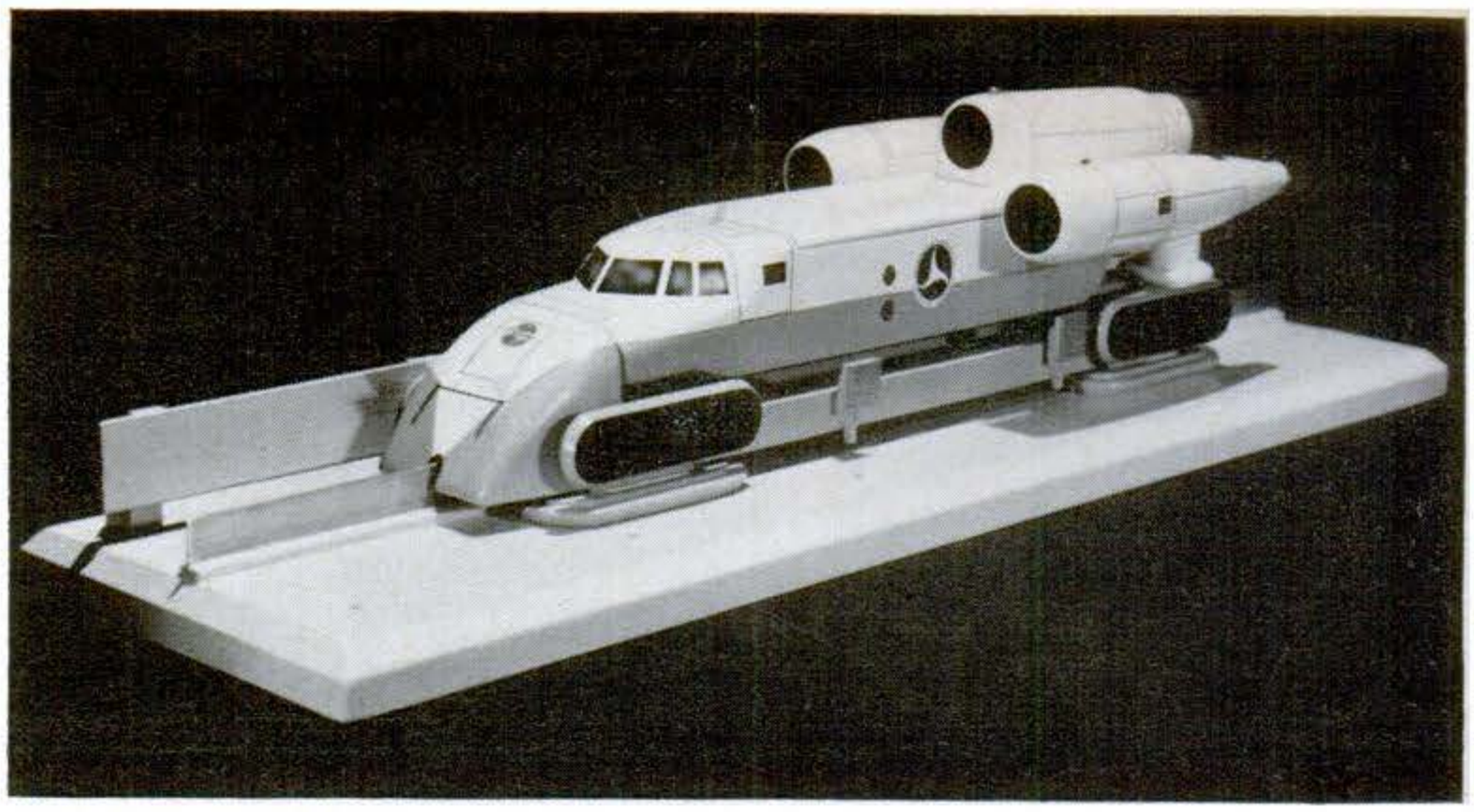
Phil and Bailey agree that spark plug design does make a difference in performance. So do over 20 million other car and truck drivers who've switched to Champions.

So, next time you line up a tune-up, insist on Champions.

Science Newsfront

Last-minute news and notes to keep you up-to-date

By ARTHUR FISHER



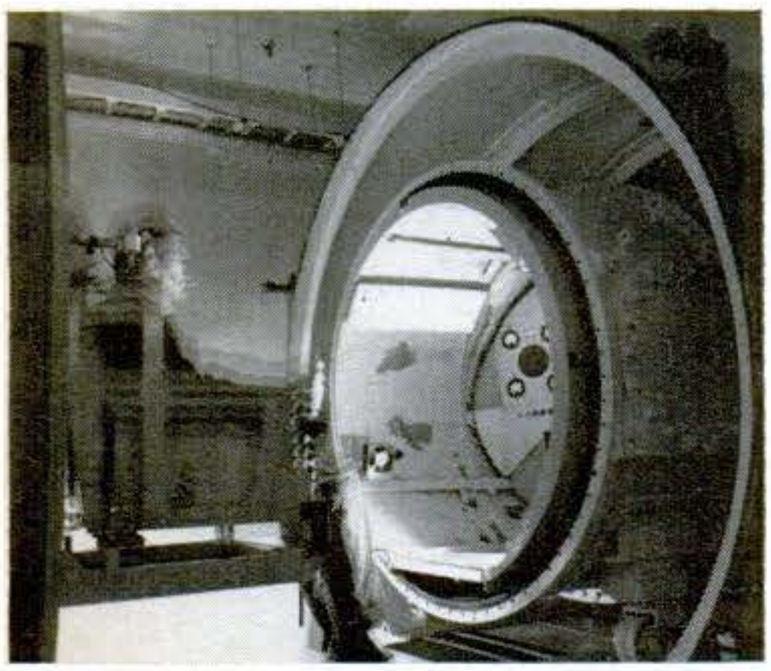
Ultra-high-speed transit vehicle to glide on air

A 300-mph tracked air-cushion research vehicle is now on the drawing boards at Grumman Aerospace Corp. The TACRV will skim along on a one-inch layer of air, held on track by other air cushions blowing against the sides of its guideway. The model above could be propelled by a linear induction motor on the center rail or by a jet engine on top.

More reasons for seat belts

Seat belts are even more effective in saving lives and reducing injury than their most fervent proponents had realized. A new seat-belt study, conducted in Utah, yielded surprising results when analyzed by the Cornell Aeronautical Laboratory. Based on 14,261 accident victims, the Cornell report states that failure to use a seat belt increases the risk of instant death or severe injury by at least 100 percent, and of less severe injury by at least 40 percent. The new study also indicates that you are 30 times more likely to be killed if you are thrown out of a car than if you remain inside. The study did not consider the use of shoulder harnesses.

Shuttle research shakes 'em up



This jiggling scientist is demonstrating the four-inch traverse of a pilot's seat mounted on a wall of the multistress chamber in Boeing's Space Center at Kent, Wash. The seat simulates the shake-up of a rocketship liftoff; the chamber also tests man's reaction to the heat, pressure, noise, and atmosphere inside the capsule during simulated space-shuttle flights. The tests are part of the NASA-sponsored competition to design the nation's first space shuttle, a craft that will transport up to 50 passengers into space and return them to Earth in an airplane-like landing.

Space "pictures" of comet

Astronomers have learned a little more about comets—those puzzling, periodic visitors from the uttermost reaches of the solar system. The knowledge stems from the first ultraviolet comet pictures taken from the Orbiting Astronomical Observatory (OAO-II) launched in 1968. University of Wisconsin astronomers have been studying the UV data from Tago-Sato-Kosaka, a comet now speeding away from the sun. Measurements confirm that hydrogen—the most common substance in the universe—is abundant in the gaseous cloud of the comet. But the UV pictures also reveal oxygen, carbon, water, and ammonia, which also appear in the atmospheres of the outer planets, and were once held in the atmospheres of the inner planets before their weaker gravity allowed these gases to drift away. Astronomers have been speculating on a possible connection between these "lost" atmospheres, leaking into the far corners of the solar system, and the origins of the comets themselves.

Calling WELK

Biotelemetry—the science of tracking the actions and functions of living things remotely—reached new heights recently when NASA's Nimbus-3 weather satellite picked up signals from an electronic collar worn by a 500-pound wild elk near Jackson Hole, Wyo. The satellite was orbiting some 700 miles above the Earth. It will make contact with the elk twice daily, and not only track the creature as it migrates to summer grazing grounds, but also record body and air temperatures. The experiment is expected to lay the groundwork for future ecological techniques that will enable scientists to track—and preserve—endangered species.

What (lunar) time is it?

The colonization of any new territory becomes very difficult if you can't even tell what time it is there. That's why Dr. Kenneth L. Franklin, astronomer at New York's Hayden Planetarium, has devised a completely new time system based on the rotation of the moon. In his system, one "lunation"—29.53098 Earth days—is divided into 30 lunes, each approximately equal to an Earth day. Each lune is divided into 24 lunours, and each lunour into 100 centilunours, each consisting of 10 millilunours. A new lunar wristwatch introduced by Helbros Watches keeps time in lunours, centilunours, and millilunours, with lunes recorded in a separate box. The hands rotate about 1.6 percent faster than those of an earthly watch. Tempus fugit everywhere.

SEM scans sickle cells

A new scanning electron-microscope system has contributed to an important victory in the fight against sickle-cell anemia, an incurable, hereditary disease named after the peculiarly misshapen red blood cells that appear in its victims. Here, Dr. Patricia N. Farnsworth, a Barnard College biologist, examines images of sickled blood cells on the screen of a new attachment, invented by Dr. Poen Ong of Phillips Electronic Instruments, that converts a standard-transmission electron microscope to

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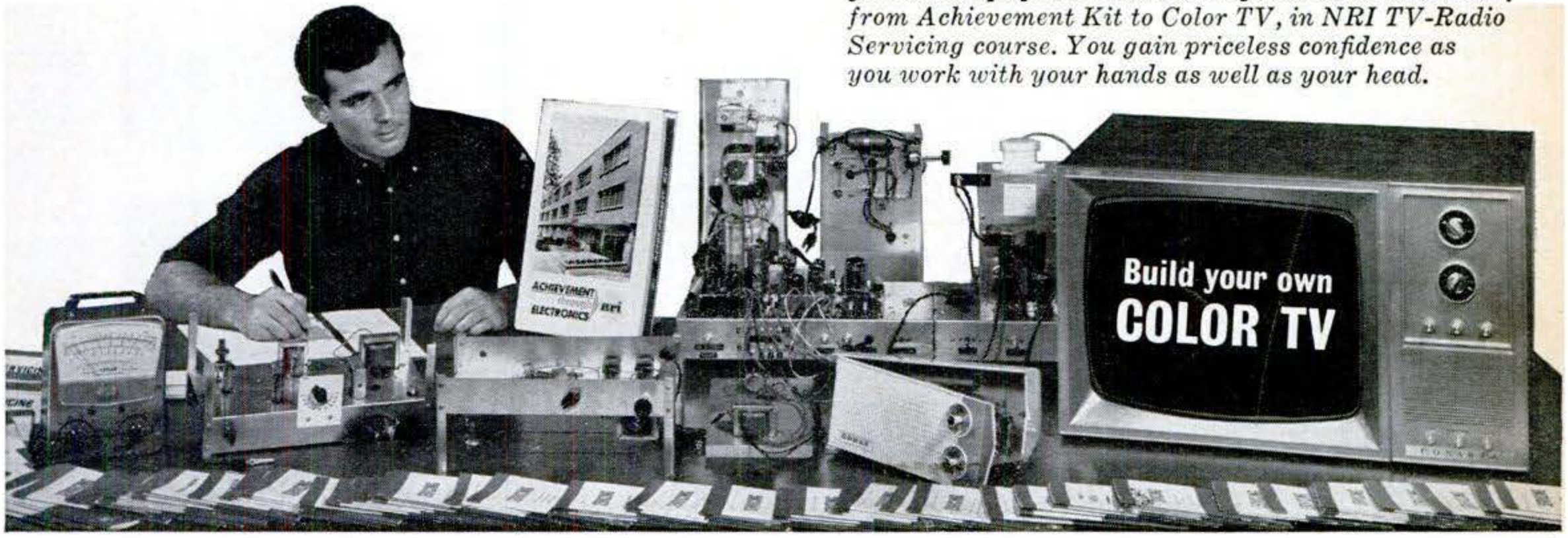

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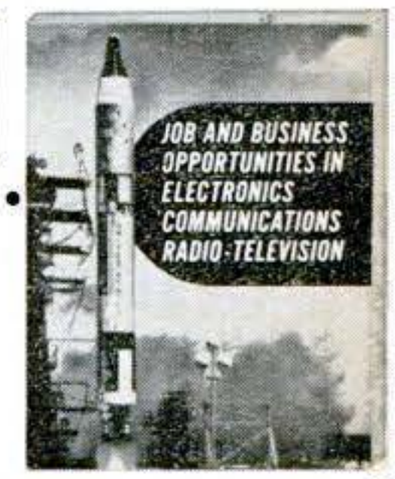

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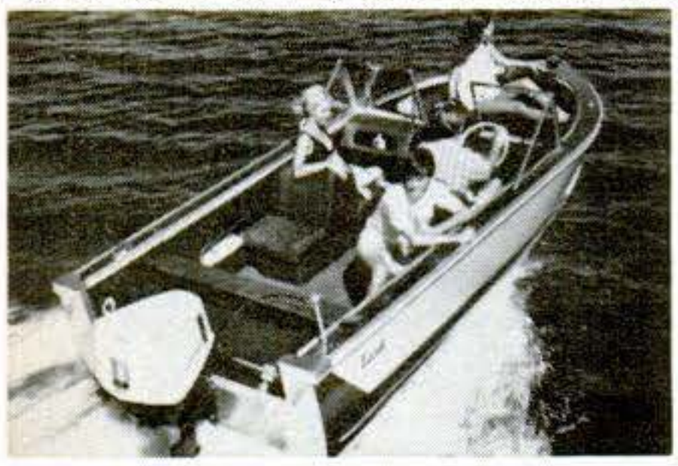

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scanning operation. (See "The Invisible World in 3-D," PS April.) Dr. Farnsworth used the scanning technique to discover a previously unobserved fluid envelope that presses against the membrane of the affected cells.

Instant pix from tiny TV tube

Shown here actual size, these two photos are part of a picture sequence made by contact printing quick-copy photographic paper (in a perforated roll) with a new and remarkable TV tube. Made by Panasonic, the 1.5-inch miniature cathode-ray tube has a fiber-optics face plate and a high-resolution electron gun, yielding pictures of 300-350 lines resolution. To print ordinary TV pictures, silver halide paper in contact with the fiber-optics tube face is exposed to light from the screen phosphors during the scanning period of a single frame—1/30 second. The processing time is about 15 seconds. Video printer will be used to make pictures from closed-circuit TV (as here), broadcast TV, computer outputs, and specialized sources.

Two continents in ¾ time

Antarctica was once attached to the southeast coast of Africa. This is the conclusion—aided by a computer—of two scientists of the Environmental Science Services Administration's Atlantic Oceanographic and Meteorological Laboratories in Miami, Fla. Dr. Robert S. Dietz and Walter Sproll estimate that some 200 million years ago, there was a single universal land mass called Pangaea, which began to break up like an ice floe, with the fragments—now our continents—drifting to their current positions. They claim that the rift between Africa and Antarctica was the first to occur. This notion is not new among supporters of the so-called "continental-drift" theory, but the scientists say their computerized fit between the two continents is the best yet obtained. They believe Antarctica has remained the most stationary of the continents, although it has rotated somewhat, while Africa has drifted far northward and rotated slightly counterclockwise since the breakup. The two land masses are now some 2,000 miles apart.

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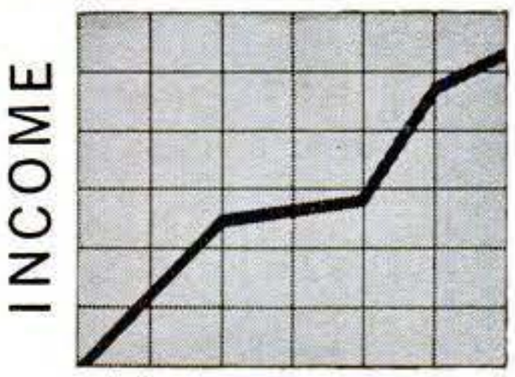

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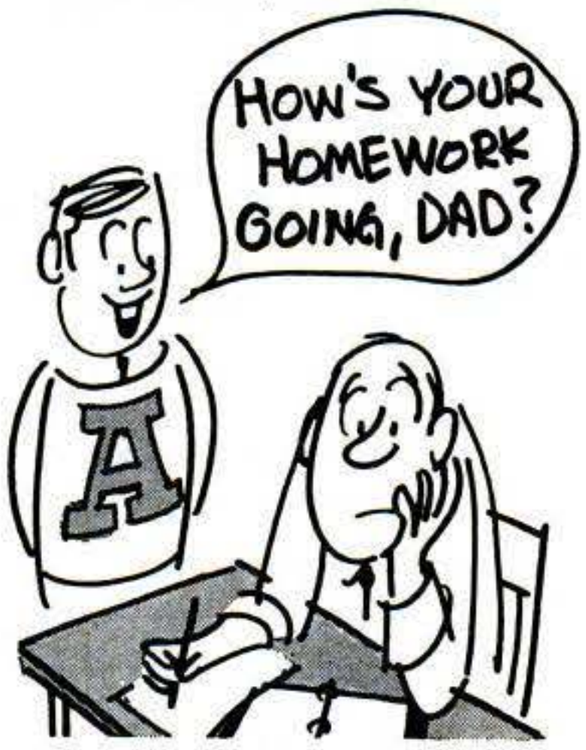

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"Serving the Need to Know"—In the home and industry

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Recreation Roundup

...on the move with PS

By HERBERT SHULDINER

Travel trailers especially designed for pickups

The Truk Traveler is a new camper with slide-in design that fits right into the bed of a pickup truck. The split-level trailer has complete bath and kitchen facilities. Its handsomely appointed interior includes a generous amount of storage space. The Truk Traveler is available in 21- and 25-foot lengths.

Reservations for national-park campers?

Ever been disappointed when you tried to find room to camp in a crowded national park? Well, it can be a frustrating experience. Hopefully, such disappointments will soon be a thing of the past if trial reservation systems become standard in parks. Howard Chapman, superintendent of Grand Teton National Park, says that pilot reservation programs are being evaluated in several sections of the country. This could lead to a big improvement in nailing down hard-to-find campsites in these popular places.

Spacious new motor home

This 23-foot Premier is a new addition to the Lifetime motor-home line. It's powered by a 318-cu.-in. V8 which puts out 212 hp. It can sleep six in its three double bunks, one of which converts from the dinette. And there's a complete built-in kitchen and bath.

Tonic for camper fever

Spring brings on camper fever for many outdoorsmen. The best cure if you're bitten by this bug is to get your camper in shape and take off for your favorite campsites.

But for a 100-percent-sure cure, don't start any trips before you've had a chance to do some spring cleaning and checking on your vehicle. Here's a short checklist to insure that your camper is in top-flight condition:

- Check wheels, tires, and brake systems. Repack wheel bearings.
- Check out the electrical system. Replace lights that aren't working, with special attention to exterior bulb sockets that may corrode during the winter.
- Lubricate glider mechanisms on pull-out kitchens.
- Inspect canvas, screens, and plastic windows for damage.
- Give the cloth a coating of bee's wax to keep it protected.
- Clear vents for L-P appliances.
- Check generators, air compressors, furnaces, automatic leveling and raising devices.

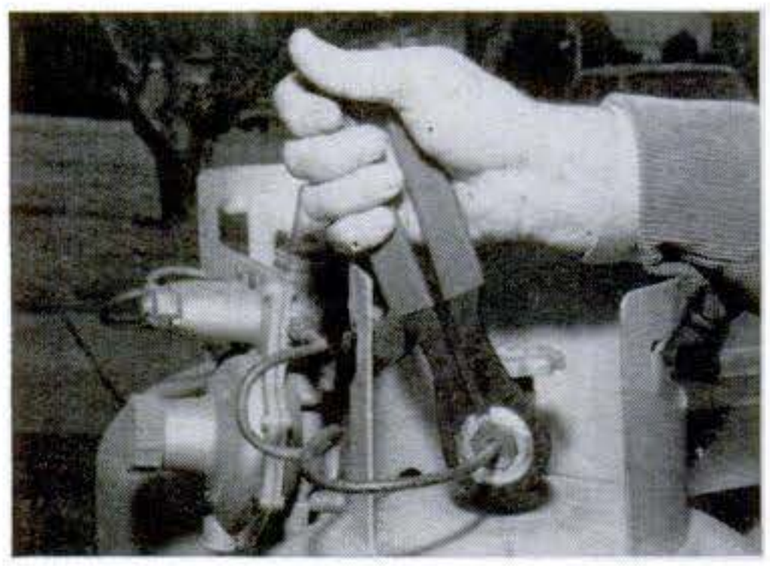
European camping holidays

Exciting tours for young people are being offered by Camping Holidays International, Inc., 7710 Computer Ave., Minneapolis, Minn. 55435. The tour provides low-cost group camping packages for persons 17 to 35 years old for $7.50 to $9 per day. You can buy a tour that lasts from three to six weeks. All camping fees, sight-seeing, and excursions are included in tour price.

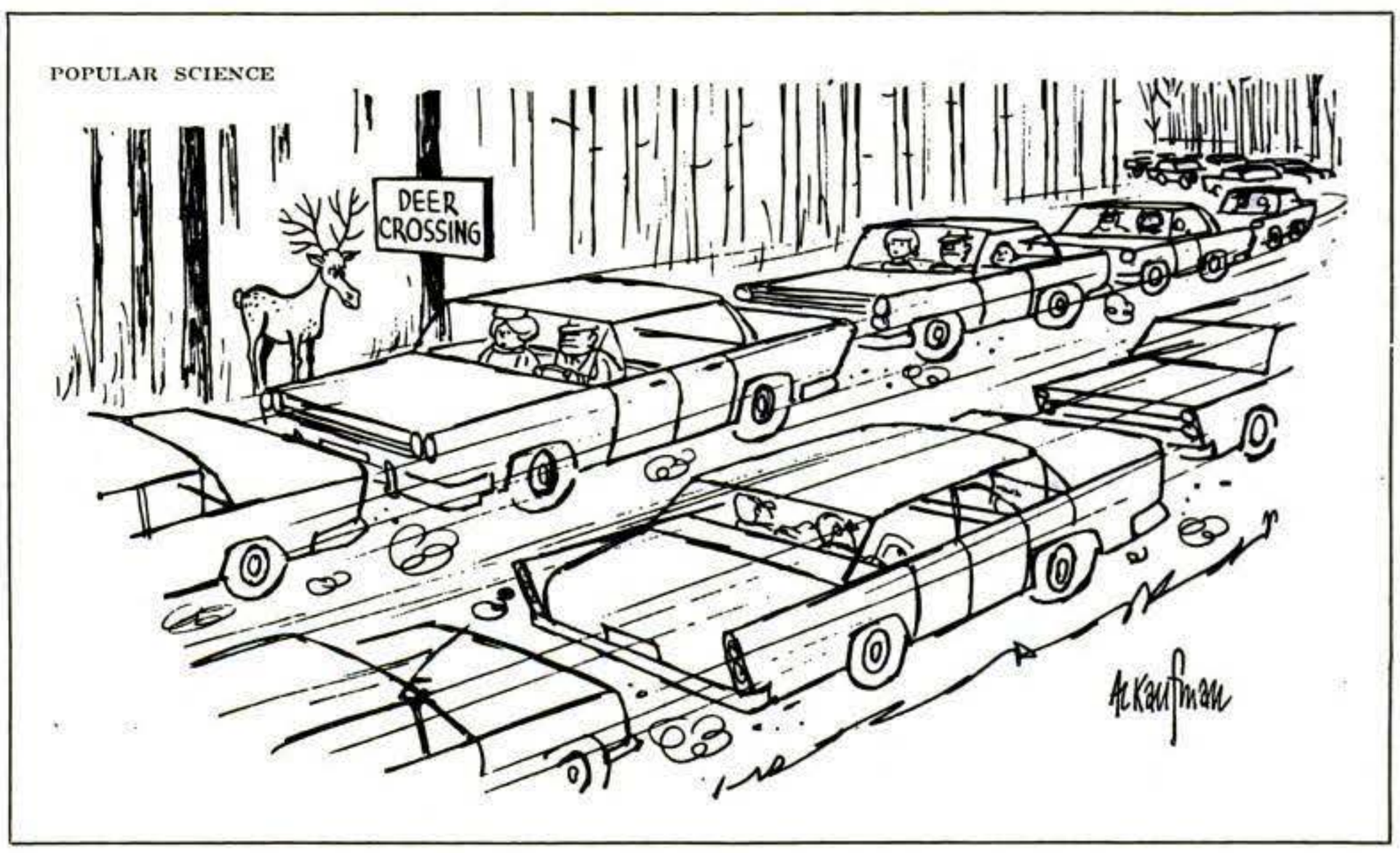
"Title Drive"

An exciting new 20-minute motion picture that shows how Cesare Scotti of Nesso, Italy, captured the world outboard title at Lake Havasu City, Ariz., last November can be obtained without cost from Solana Studios, Naples, Fla., for showing to clubs. The 16mm color movie captures the frenzy of the race, which Scotti won with an average speed of 73 mph in a Molinari powered by twin 115-hp Evinrudes.

Safety wrench for L-P connectors



The Tork-Grip is a handy new tool made for use on travel trailers, campers —anywhere you use low-pressure-gas cylinders. It comes in 7/8- and 1 1/8-inch sizes and will not over-tighten or spark. Price of this useful tool is $6 from Bristol Enterprises, 6755 Southwest Ave., St. Louis, Mo. 63143.



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PERSONAL-USE REPORT

New Bandsaw Sands, Too

Belt-sander accessory is standard equipment with this 12-incher—so are sawdust ejection and color-coded controls

By R. J. DeCRISTOFORO

True, there have been bandsaws that convert to sanders by means of optional accessories, but with this saw the conversion isn't an afterthought—the equipment for the extra operation is part of the initial package. After a simple change-over, a ½"-wide abrasive belt tracks over the wheels just like a saw blade.

It works very much like those belt grinders that have become popular in recent years. Like them, it can be used for metal surfacing and tool sharpening, too. It's new from Sears.

Nice as this extra feature may be, the tool's performance as a *bandsaw* was the main consideration in my shop tests. Mine came with a ⅓-hp motor, the minimum recommended in the catalog. Since my jobs might well include max-cut operations like the 6" resawing job below, I'd prefer the ½-hp option.

Blade-adjustment mechanism includes an indicator arm that reads off the correct tension for various width blades (80" loops come ⅛" to ½" wide). This shows through a window and can be read front or back—a good feature, since finger-flexing for blade tension is arbitrary, at best.

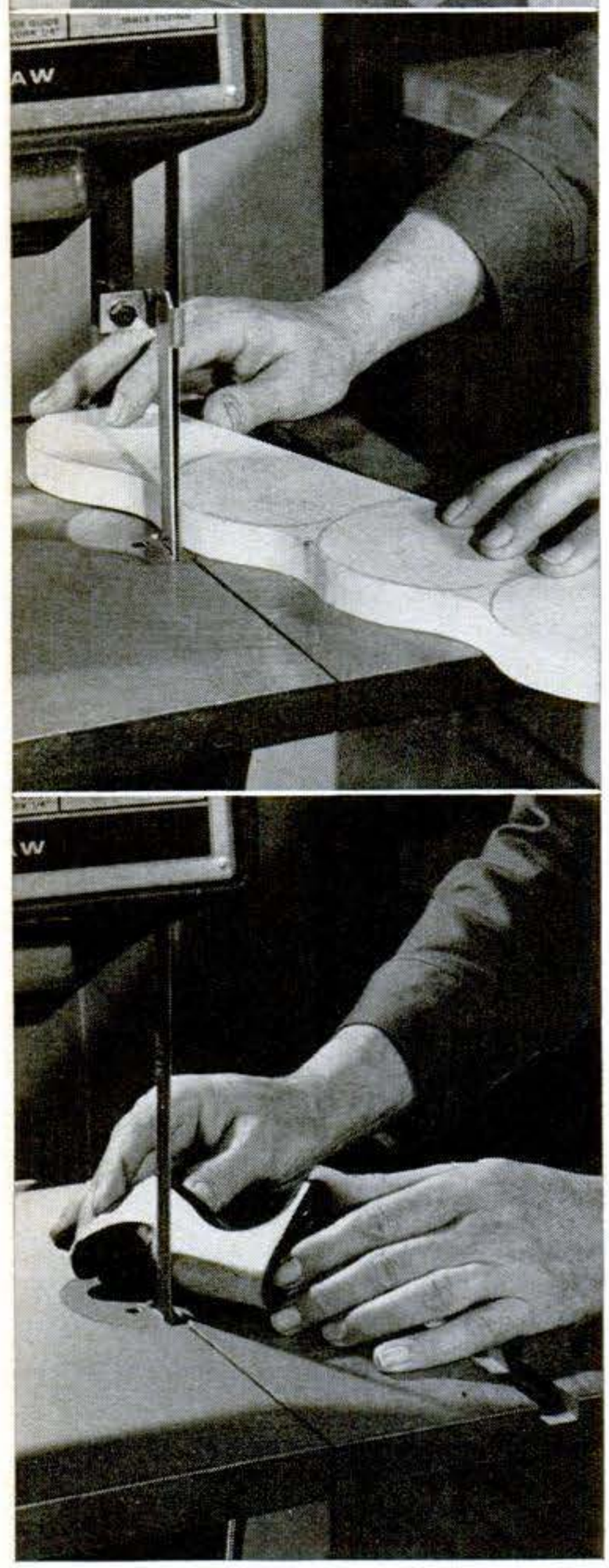
Tracking (by tilting the top wheel) is achieved by turning a setscrew running through the wheel's center. Certainly not an over-design, but it works and holds—that's what counts.

Blade guides are easily adjusted and work in standard fashion, except that the housings are ledged to provide an accurate indication of blade-to-guide relationship. This is better than having to peer into a tight, dark area in order to make the critical lateral thrust adjustment.

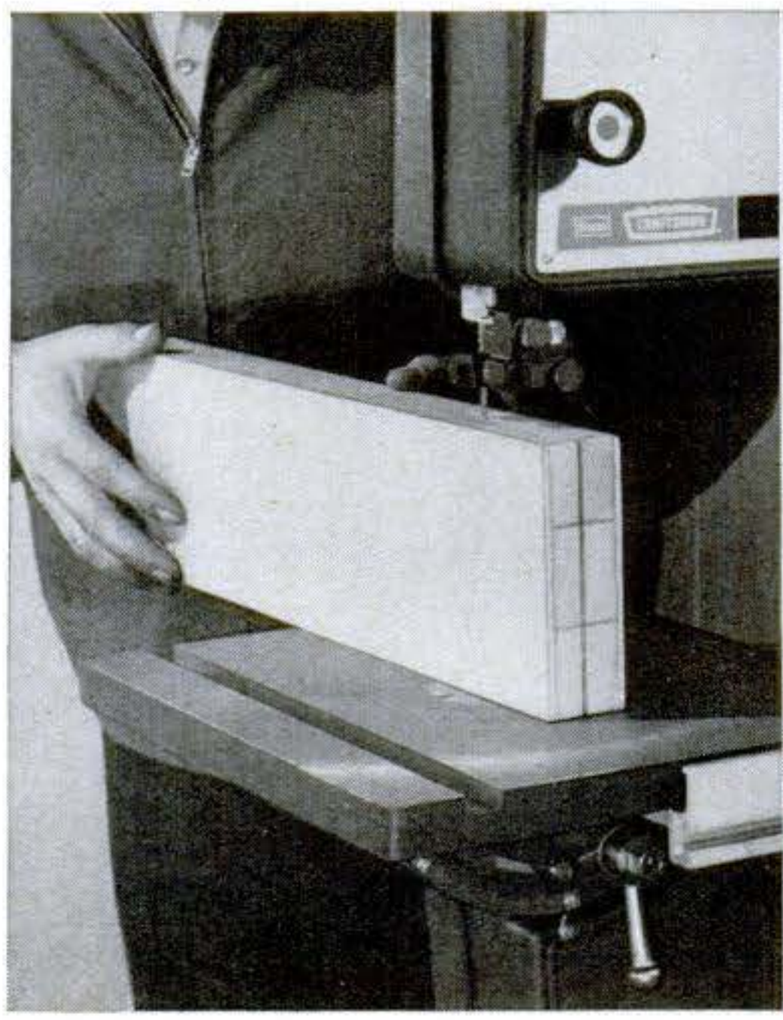
A good attempt has been made to provide for external sawdust collection. There's a tight-fitting cover, a deflection shield around the cut area under the table, and a rubber-elbow outlet at the base (top photo). You either hook a shop vacuum to this elbow or place a box beneath it.

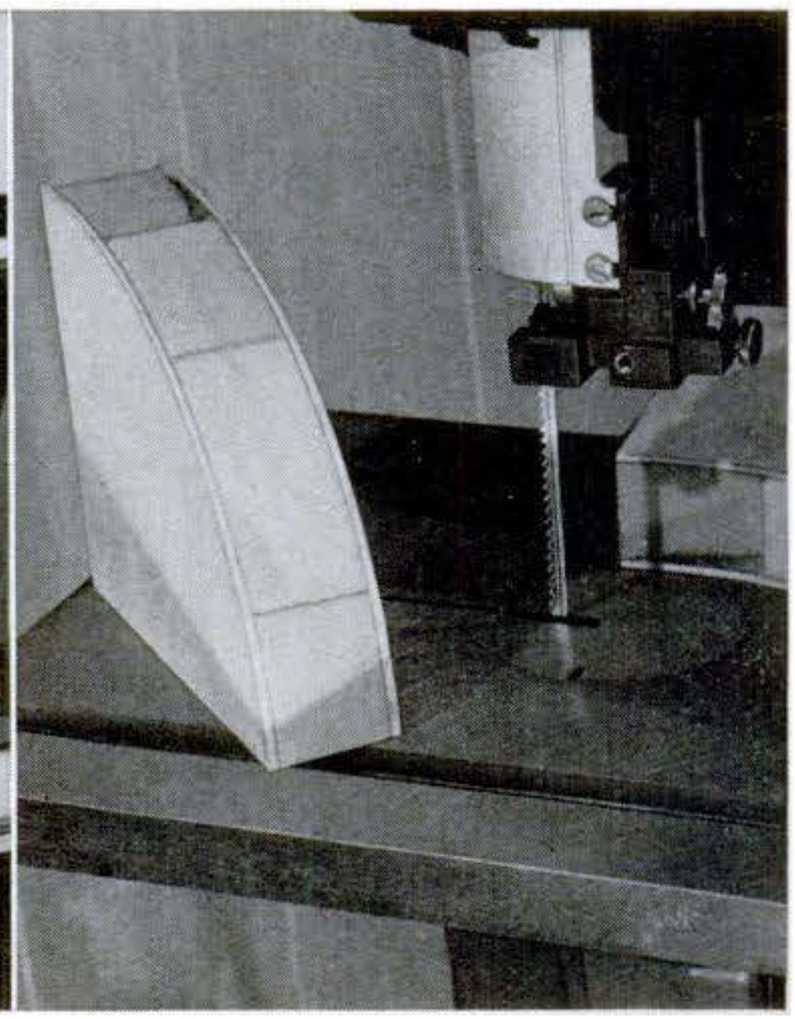
Capacities let you cut to the center of 24" stock. Table size is 12½" by 14¼"—ample for average work. There's a groove for a miter gauge, and a rip fence is a $13.99 accessory. The table tilts to 45 degrees.

The machine features Craftsman color-coding; adjustment knobs and screws match the picture panel. Less motor and stand, it costs $136.50.



Heavy-duty jobs—such as resawing, below—call for ½-hp motor. Any resaw cut should be made slowly to help avoid bowing blade in cut. Though the ¼" blade shown did the job, widest blade you own is best for this. Smooth finish on cuts (right) is evidence of more than sharp blade: It indicates that saw runs smoothly, with minimum vibration.





Special platen and table insert let you mount an abrasive belt in place of the saw blade, as in center photo, above. Tracking and tensioning are handled in regular way With narrow belt, you can do jobs that normally require a drum. Belt without platen (bottom) is good for sanding round work, compound curves—using light pressure.

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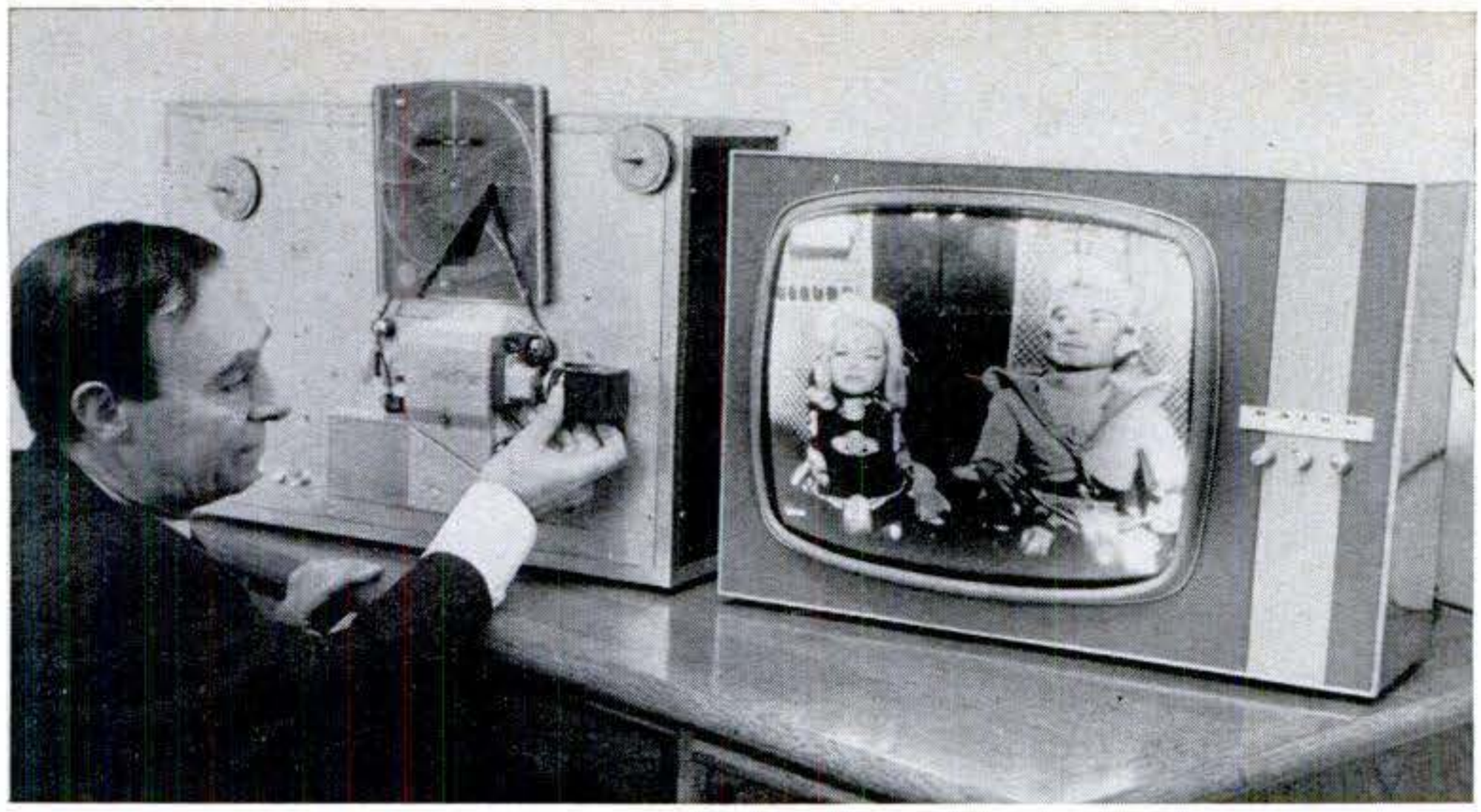


Leonard Cassini, director of Vidicord, adjusts the "telecine" device he originated. This oversize prototype was built for handling large, 14-inch film spools.

See Your Home Movies on TV

Does the idea of seeing your home movies on television sound appealing? You'll be able to soon, when the Vidicord, a new British invention that is part projector, part TV camera, becomes available.

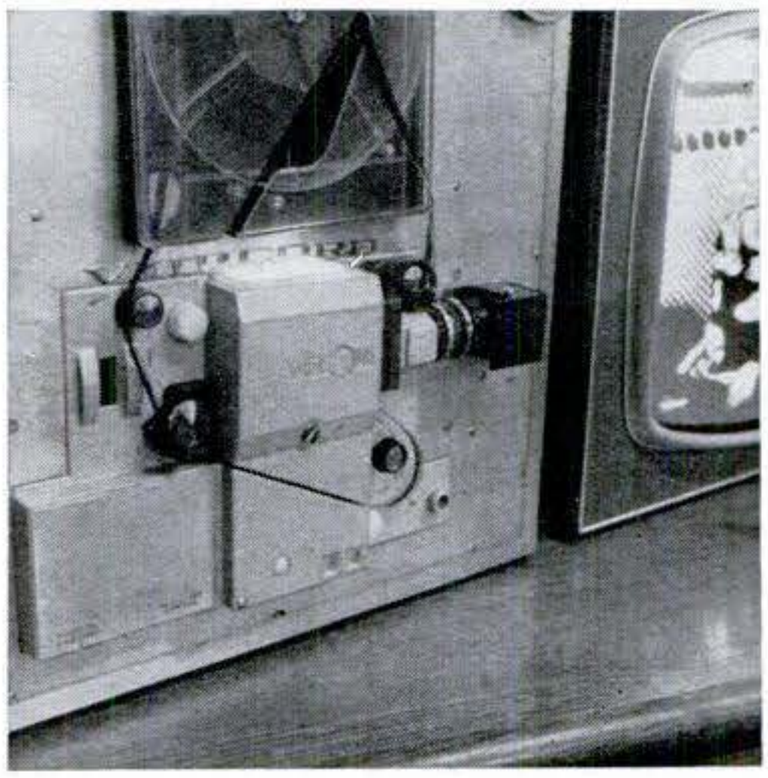
You just plug the output of the Vidicord into your TV antenna connection, switch on the set, and sit back. There's no need to draw the curtains or turn out the lights. If there's sound on your film you'll get that, too. And you can hold any frame at the flip of a switch for an instant still.

Here's how it works: You thread your film into the machine as you would with any projector. A low-temperature light source behind the film projects a crisp image through the focusing lens onto the sensitized target plate of the vidicon camera tube. The cold light will not warp or burn the tiny 8-mm frame even when stopped for a still.

The tube scans the image and its amplified output modulates a microwatt RF oscillator to produce the video signal. For sound, there is a magnetic pickup head.

Oscillators operate in one of the UHF bands, and are tuned to the frequency of an unused channel on your TV. The combined signals are wired into the set through a coaxial cable, so you just twist the selector to change over from broadcast programs to your own closed-circuit one.

Though still in the pre-production stages, the Vidicord has already been successfully tested in a hotel in Spain, where filmed shows and tourist information are piped to TV sets in individual rooms. The London Hilton may be another early customer, using the equipment to plug into the hotel's facilities.



Closeup of Vidicord shows simple threading of 8-mm film through projection and sound section. Lens throws image a few inches onto target plate of vidicon tube.

Schools would be another natural for this device. Educational films could be shown simultaneously in any number of classrooms. Doctors could use it, too, for consultations.

Sets for home use are still in the future. Volume manufacture has not yet started, and the present price runs around $500. A lower-priced version under development works as an "optronic reproducer." It bypasses the projection process, scanning the illuminated film directly. Color? Still a long way off, although you can still get a black-and-white screening of color films.—*David Scott*

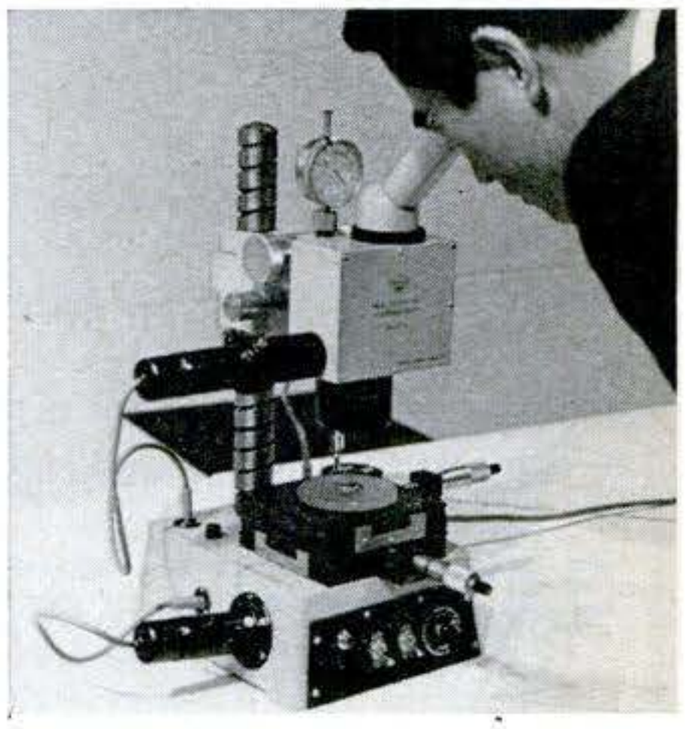
New Scope Measures Depth with a Triangle of Light

How would you measure the depth of tiny cracks and holes, plot the irregularities in a rough surface, or check the angle of a miniature incline? A new depth scope does it with a triangle of light, and detects variations as small as 1/100 of a millimeter.

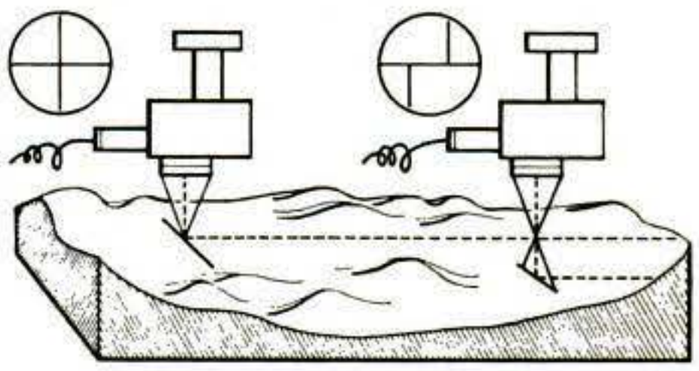
The new device, made by Nissho Seimitsu Ltd. of Tokyo, Japan, resembles a microscope. It shines two intersecting beams of light at the object being measured. The apex of the triangle formed by the beams is fixed at a specific distance. This optical point is used to probe the object.

It's easy to use. After a few seconds' instruction I used one to take readings from a tiny watch core—readings that compared almost exactly with a printed list.

Applications of the scope? Exact duplication of small parts no longer being manufactured, and the measurement of tiny gears, drills, and taps—for example. Use is limited only by the patience of the operator.—*Joseph Zmuda*



Look through the tilted eyepiece above and focus the scope on a reference point on the subject. Red hairlines in the eyepiece will line up. Move subject to measure another point, turn adjustment knobs to realign the hairlines, and a dial atop the scope gives a direct reading of the depth.



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If Your Car Jumps...

On old country roads, dips and rises are often more severe than they look from behind the wheel as you approach. Some hillcrests are so sharp that your car will actually jump. While airborne you can't steer and you can't slow down. What can you do? Hold the steering wheel absolutely still to make sure the front wheels point straight ahead. Use both hands. If you turn the wheel you could end up in the ditch after landing. Brace yourself for the landing—the suspension may bottom and the shock can be severe. Press your left foot firmly against the toeboard and wedge yourself firmly against the seat back. Keep off the brake pedal. Locking up the wheels will only aggravate the control situation when you land. Ease up on the throttle, but try to keep the wheels turning at the same speed your car is doing. Most cars will bounce on landing, but if you follow these rules, your car will continue traveling in a straight line and you will remain firmly in control.

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Model sits on a stack of eight chairs, each of which will expand to look like the striped chair in the background.

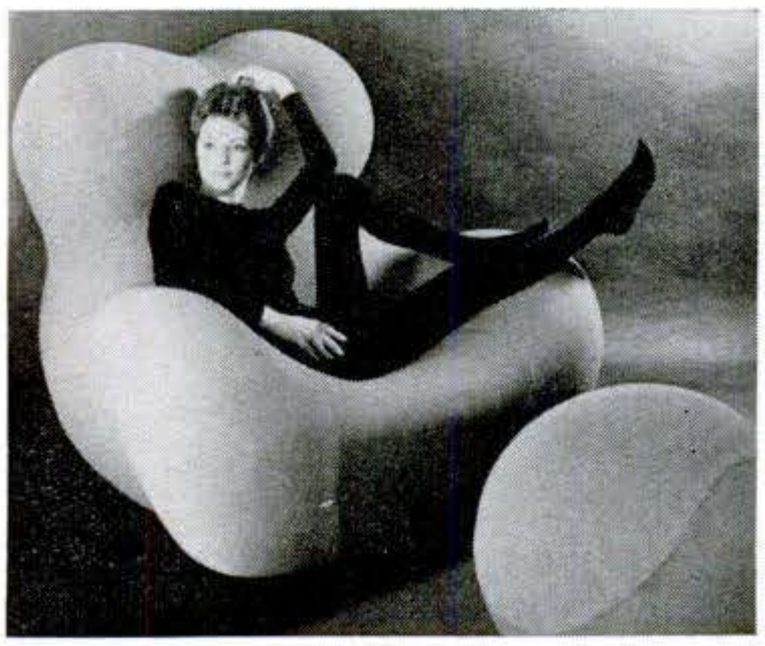
Foam Furniture Rises Like Bread

What goes up and doesn't come down? A new kind of furniture called "Up." You buy it flat-as-a-pancake in a vinyl package. Cut open the vinyl and the pancake automatically expands into a modern chair. Once expanded, it cannot be recompressed and cannot be punctured.

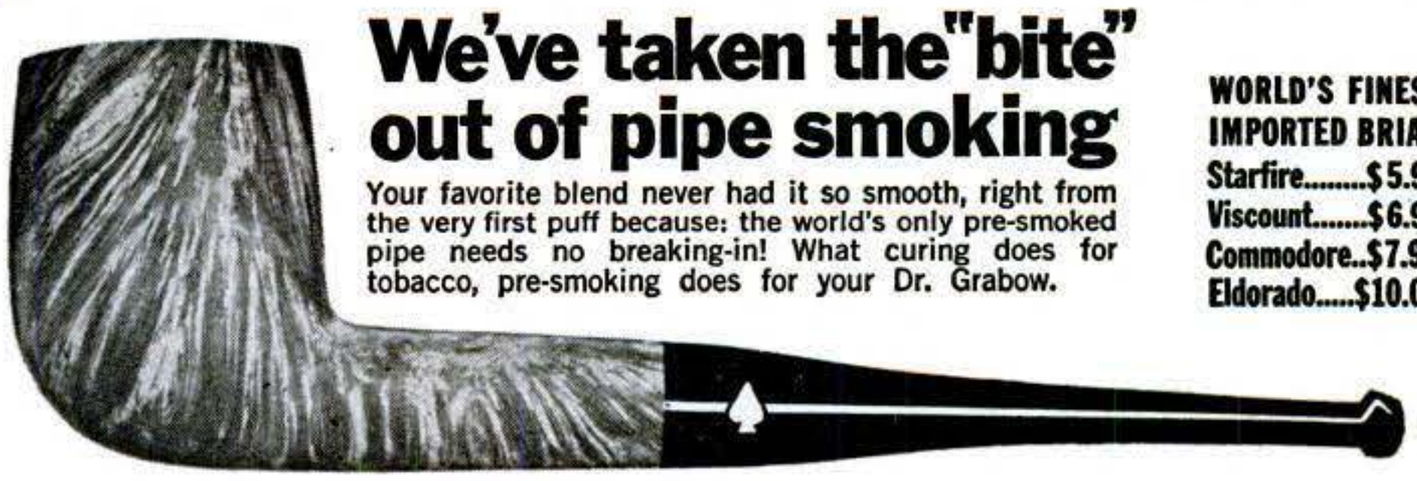
It works like this: At the factory in Italy the furniture is molded of polyurethane foam, and covered with stretch upholstery. Then, in a vacuum chamber, the piece is compressed to force out the air, and sealed in the airtight package. Open the package and the foam absorbs air, expanding to its designed size and shape.

The foam in this furniture is very heavy, and dense enough to fully support you when you sit. The chair below, for example, weighs 90 pounds—packed.

Price? A child's chair costs $63; the armchair below costs $588. In the U.S. you can get it from Atelier International, 139 E. 57th St., New York City 10022.



Armchair and spherical ottoman are two of six designs you can get in Up furniture.



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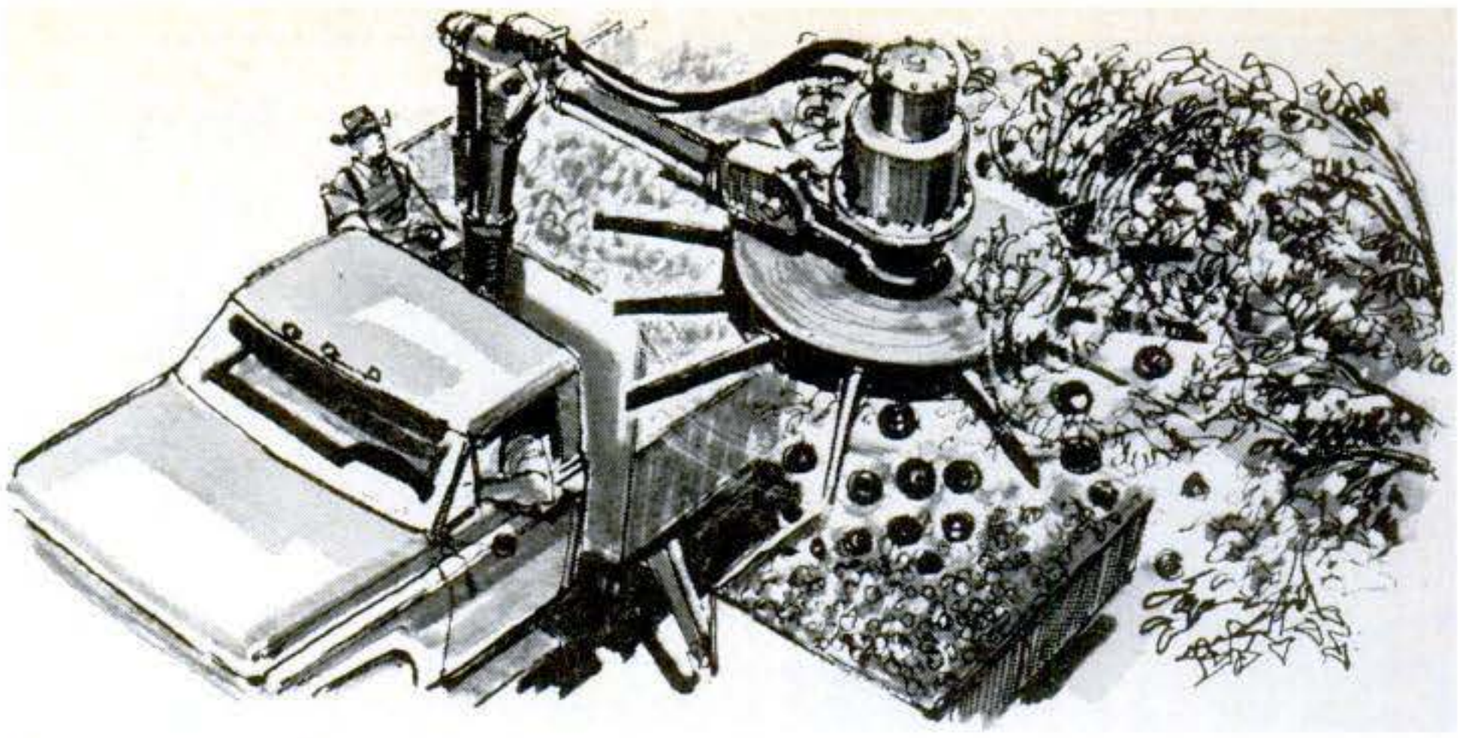
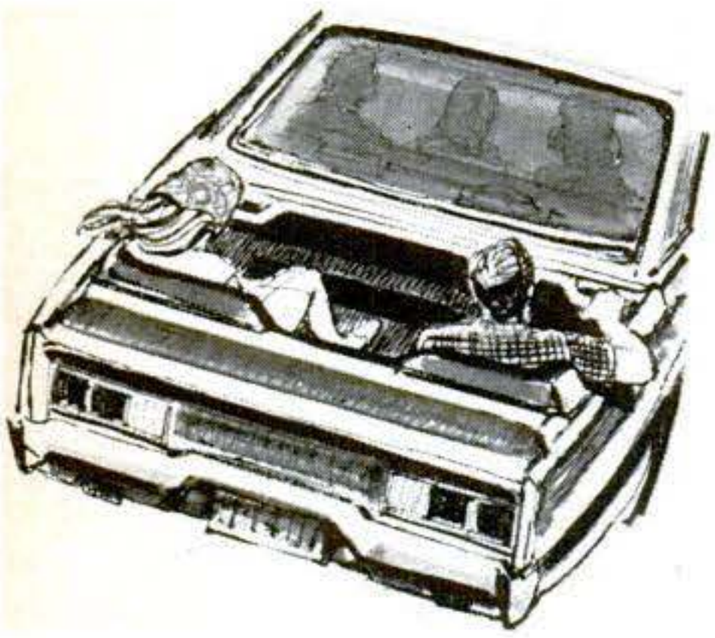
New Ideas from the Inventors

ILLUSTRATIONS BY DANA RASMUSSEN



Rocker arm gathers fruit. Carried and powered by a small truck, a recently patented harvester (above) would jostle ripe fruit or nuts off trees. Power would be fed through a gear train to off-center weights that would vibrate long "fingers." They'd roll lightly through the branches without damaging a tree. A swing-around catch basin would collect the harvest.



Drop-in seats convert trunk. Rumble seats may not be gone forever. A molded plastic insert like this could put extra seats in a trunk well. You'd remove the trunk lid by unscrewing it at the hinges, and drop the seat-and-floor unit into the deck. Extra options: fitted cushions and a locking cover.

Paint-can apron catches drips. Hooked over the rim of a paint can, a flexible pocket could be adjusted to fit and hold a brush without bending or weighting the bristles. A saucer-like apron, held to the bottom of the can by prongs, would catch brush drippings and protect work surfaces.

Snubbed hook protects boat. Fixed between knots in a mooring line, telescoping arms could be hooked to a dock and adjusted to space a boat's bow and stern at proper mooring length. It would let the boat ride easily but keep it from being driven against the dock or pilings by waves or rough weather.

Lifts fit wall panels. Self-fitting, self-trimming partitions might make it easier to divide room spaces. Cut to less than room height, these panels would lift easily into floor and ceiling channels. Threaded feet would permit quick, snug height adjustments. A hook-on baseboard would trim and cover both the feet and the floor moulding for a complete wall.

Safety cap meters dose. Both strength and coordination would be needed to move a measured dose of medicine (in powdered, liquid, or capsule form) out of this childproof bottle. Squeezing the upper part of the plastic cap would advance a dose into the neck. A separate squeeze farther down would close the portioning valve and eject the dose.

The following patents have been issued on these inventions: **Fruit picker**—*No. 3,413,789 to H. Studer, Davis, Calif.;* **Rumble seat**—*No. 3,413,-031 to R. Gafvert, C. Chaney, Yellow Spgs., Ohio;* **Paint-can apron**—*No. 3,407,429 to L. Di Nardo, Leominster, Mass.;* **Mooring hook**—*No. 3,406,651 to J. Jalbert, Dumont, N. J.;* **Tiltable panels**—*No. 3,408,781 to G. Pollock, Parma Hts., Ohio;* **Safety cap**—*No. 3,481,513 to G. Ram, Cedar Grove, N. J.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D. C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address. Questions can't be answered by mail.

They say back pressure from exhaust pipes and mufflers causes a drop in horsepower. In your opinion, how would these dodges work: 1) Make a bulge on the end of the tailpipe and insert it in a larger short tube, ends open; 2) have the bulge in the surrounding tube, leaving the tailpipe straight; or, a simpler setup, 3) put the bulge in the end of the tailpipe with no outer tube?

RAYMOND MYERS, Clemson, S.C.

Well, you surely have done a lot of thinking about this, and I am sorry I can't include your drawings here. But while you have your thinking cap on, keep this in mind: During legal driving speeds of 10 to 80 mph, an engine can produce 400 to 700 cubic feet per minute of exhaust. Just how much negative pressure, or vacuum, would your gadgets have to produce to put that big a hole back there in the atmosphere?

I have a 1968 Datsun 510, which features a 96-c.i.d. four-banger engine that develops 97 hp at 5,600 rpm, thanks to an 8½:1 compression ratio and an overhead cam. Would upping the compression one point, a ¾ grind on the cam, and a home-brew ram-air job give added performance worth the expense? Also, what are the chief causes of clutch chatter on stick-shift jobs?

W. H. BAKER, Cridersville, Ohio

Regarding your proposed soup-up: It seems to me that better than one hp per cu.-in. displacement isn't too bad. I'd guess you could run up the compression ratio a little, grind a bit more cam, and get more cold air to the carb and gain enough power to feel. I don't think the engine would then be long for this world. Would the gain be worth the expense? I doubt it. For clutch chatter, there are three main causes: bad motor mounts, uneven release on the pressure plate, and oil or grease on the clutch lining.

I have a '63 Chevrolet 327, 250-hp with automatic transmission, full power, and factory air. I plan to replace the quadrajet Rochester with a big AFB carburetor and adapter, then install a racing cam with a 280-deg. duration and 0.460 lift. Will the stock springs and lifters handle this modification? How will takeoff be affected? If this setup will work, how will a cam of 300-deg. duration and 0.450 lift perform? What other modifications would help?

D. W. ROBINSON, Dallas, Tex.

Here is what I'd do on that soup-up job: Cut 0.030 off the heads; put in the Chevy 302 high-performance cam, lifters, and springs; install the Hi-rise 302 intake manifold and Holley 850 c.f.m. carburetor and a dual low-restriction exhaust system. This far, you would feel the 'lift' pretty good. If you wanted to spend still more money for a gain in power, you could put in the 327 high-compression pistons, or get the equivalent from T.R.W. But you might better pull the engine and overhaul it while you are doing this or the added steam will soon make it a very sick engine. You can get all the parts mentioned from Chevrolet, and your dealer will have an instruction book for advice, part numbers, and prices.

My 1968 Chrysler Newport with a 383 V8 engine won't give more than 7½ mpg in city traffic, and 9½ to 10 on the highway. The Chrysler people have changed the carburetor and checked the transmission. The timing was checked and new points and plugs installed three times in 17 months, to no avail. Is there some explanation for this poor mileage? I just can't afford to drive it this way.

ARNOLD WEINBERG, Stamford, Conn.

Your problem is shared with many other drivers. You can't get a whole lot of improvement in mileage, but you may gain three or four miles per gallon. Start out with yourself. Study some of the articles on economical driving habits: you may find you have been using more gasoline than needed to get where you're going, without getting there any faster. Your next step is to take the car to a shop that has a combustion analyzer such as the Sun equipment. Let them work with it until they get the proper air/fuel ratio throughout the range. Good analyzing equipment will break the problem down from ignition or carburetion, or both, and when they pinpoint it, the air/fuel ratio will fall in place and you'll get the maximum mileage you're ever going to have.

After replacing the fuel filter, fuel pump, spark plugs, and starter on our '60 Pontiac Catalina Safari, it wouldn't start. Checking the oil I found it full of gasoline. After changing it, the car started, ran good for a week, then the oil was full of gas again. What's the cause? There was no water in the oil so it couldn't be the head gasket or block.

HERB CLARNER, Kokomo, Ind.

I hope you haven't blown up that car by now. The only two spots I know where fuel can get into the engine are the pump and carburetor. Either your fuel pump has a leak in the diaphragm, or your carburetor needle and seat aren't holding. But with the amount of fuel you speak of, it is almost a cinch that the fuel pump is the cause.

I own a 1967 Camaro with a 327-c.i.d. power plant and air conditioning. I feel that the brakes are inadequate for this car. Would you think it wise to install front disk brakes and, if so, what would be the cost, where could I obtain them, what are the installation problems?

GUY HOUSE, Dayton, Ohio

Chevrolet made a bolt-on deal for that car in 1967, and I believe the '68 Camaro optional front disks will bolt on as an assembly, too. They do help and are not a problem. Cost is a question for your Chevy dealer to answer. Offhand, I doubt that the switch would be worth it in a three-year-old car; but if you are in big trouble, and plan to keep the car, it could be worth it. Installation would not be too hard, but is not a job for an amateur. The master cylinder must be changed, as the disks want no residual pressure on them.

We have been arguing about the types of gasoline that should be used in today's cars. I insist that using regular gas in these engines—even those equipped with two-barrel carburetors, and for which regular is recommended—would cause excessive carbon buildup and loss of power, especially in cars driven only around town at speeds not above 40. I plan to buy a Maverick with a 200-cu.-in. six and use only high-test gas. Right?

MICHAEL MIRON, Scarsdale, N.Y.

Better stick to the manual, for you are wrong. A lot of engineering talent goes into determining what is best for each engine, and it doesn't pay to try to second-guess them. I could explain in detail why you're wrong, but there isn't room here. Anyhow, you might as well get used to a lower octane—so-called high-test gas is on its way out.

A mechanic the other day told me that if you turn your car lights on for a few seconds, then off, and start the car, it will start better in cold weather. Have you heard this?

JOHN E. ALEXANDER, M.D., Evansville, Ind.

Much weird folklore about autos has come my way, but this is the first time on this. I've tried to figure out how this could work, but I only get a big, fat zero for an answer.

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By JAN P. NORBYE
PS Automotive Editor
and JIM DUNNE
PS Detroit Editor
PHOTOS BY DAVE HOUSER

Since the new Camaro was presented last February, we have been getting calls and letters asking for a test report. The third-generation Camaro was originally planned as a '71 model, but GM decided to rush it into production ahead of time under the pressure of growing competition from new varieties of Mustangs from Ford, Chrysler's all-new '70 Barracuda, and the latest Javelin by American Motors. We arranged to test all four together.

Sportiness the keynote. It's not only in the styling of these cars but in their entire character. They offer comfortable seating for two in front bucket seats, and carry two occasional passengers in the back. Mustang's back seat is little more than a padded shelf over the axle. Camaro's rear seat is almost as low as the floor, and tends to get passengers wedged into one

Continued

Almost a Trans-Am racing scene, you might think, looking at the four Popular Science test cars spread out on this long turn at Bridgehampton. In the foreground is the Mustang Mach I. Hugging the inside of the curve is the new Camaro SS. Near the outer edge, behind the Mustang, is Plymouth's 'Cuda 340. In the rear, at the center of the track, is the Javelin SST.

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It's possible to sit in the back of the Camaro with one foot flat on the ground outside. Entry and exit are made very easy by the extremely wide door—which may be a drawback when parking in tight spots.

fixed position. Back-seat riders in the Javelin are forced into a strange, upright position. The Barracuda suffers particularly from lack of rear leg room.

Each car has a list of options as long as an airline schedule, covering powertrain combinations, chassis and tires, trim, safety, comfort, and convenience items.

The equipment on our test cars was a true sports-car enthusiast's choice: small-displacement V8s with four-barrel carbs, four-on-the-floor, power steering, power disk brakes, and wide-tread tires.

As a group, these cars come closer to Corvette performance than their predecessors [PS, Feb '68 and Jan '69]. Now, at last, they are real sports cars—not just sporty compacts. These four make up the low-priced category. A report on the high-priced models (Pontiac Firebird, Dodge Challenger, and Mercury Cougar) will follow next month.

Chevy's Camaro. This is the heaviest car in the group, despite its compact dimensions. Most of the extra weight is accounted for by the new "international look" Fisher F-Body, with its reinforced roof structure and guardrail-equipped doors, plus the heavier front stub-frame. The chassis has some important refinements, too.

The track is wider, the steering linkage is mounted forward of the hubs, and the power steering has variable response tailored to the car. Multi-leaf rear springs have replaced the earlier single-leaf type. Our SS test car also had a rear stabilizer bar. All new Camaros have front disk brakes.

We found the Camaro offers family-car ride comfort, yet did extremely well in the handling tests. It was quiet and rattle-free, with a remarkably smooth engine and transmission. Inside, it had the best finish, with neat and attractive upholstery and soft trim. The wood applique in the door panels matched that on the instrument panel and steering wheel. The curved panel had only a fuel gauge in addition to the speedometer. Optional battery, oil, and temp gauges are so small they are difficult to read. The radio antenna is tamper-proof—inside the windshield glass.

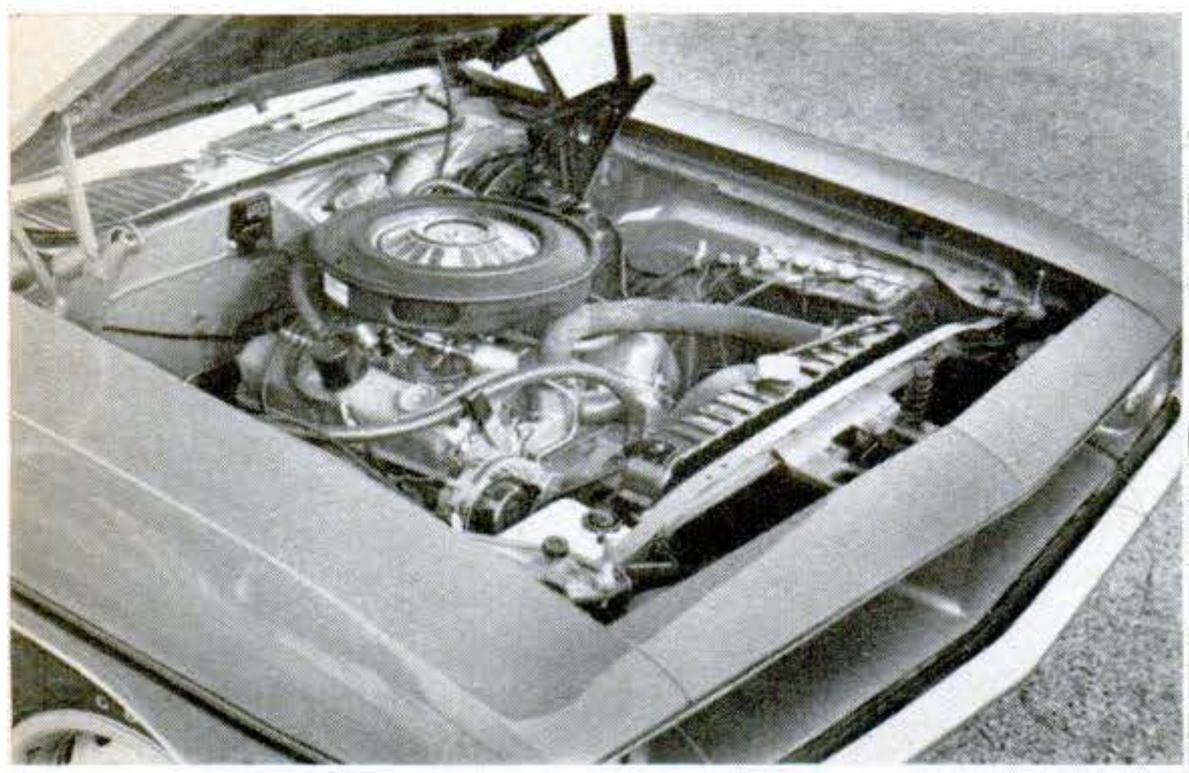
This car's ultra-small glove box is just about big enough for the owner's

Continued

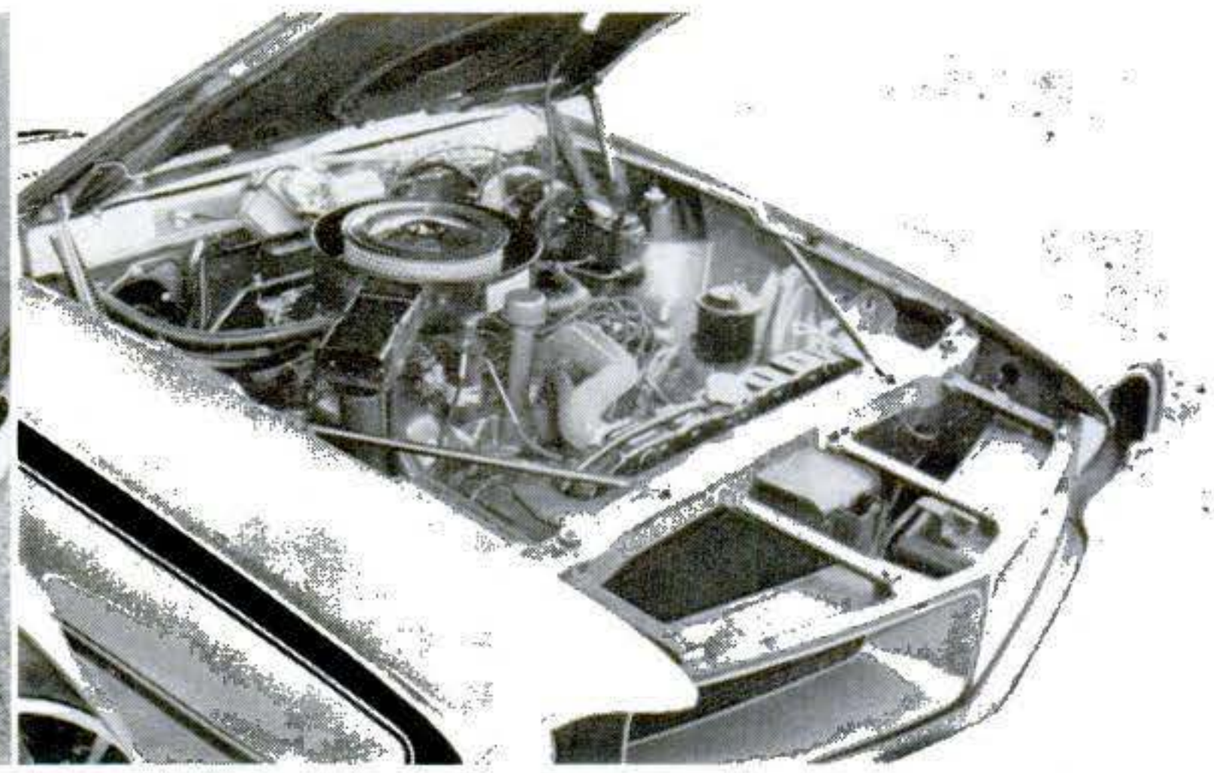
Best interior finish was found in the Camaro, but we also found many irritating details (glove box, seat-back release).

Mustang's steering wheel is well placed, but top of instrument panel seems needlessly high, small controls too far away.

Mach I's entire "sports slat" panel (of plastic) can be lifted for backlight cleaning. Louvers do not obstruct your rear view.



Barracuda's 340-cubic-inch V8 surprised us with its power and performance. We found the plugs easy to get at, the distributor (behind the air cleaner) difficult. The hood is held down by four separate locks—conventional release and catch, plus two racing-type cotter-pin devices.



Spring towers in American Motors' Javelin do not steal much underhood space, but the engine compartment is not very tidy. The air preheater duct to the air cleaner blocks access to the front plug on the right bank, and the steering arms block access to the oil filter from below.

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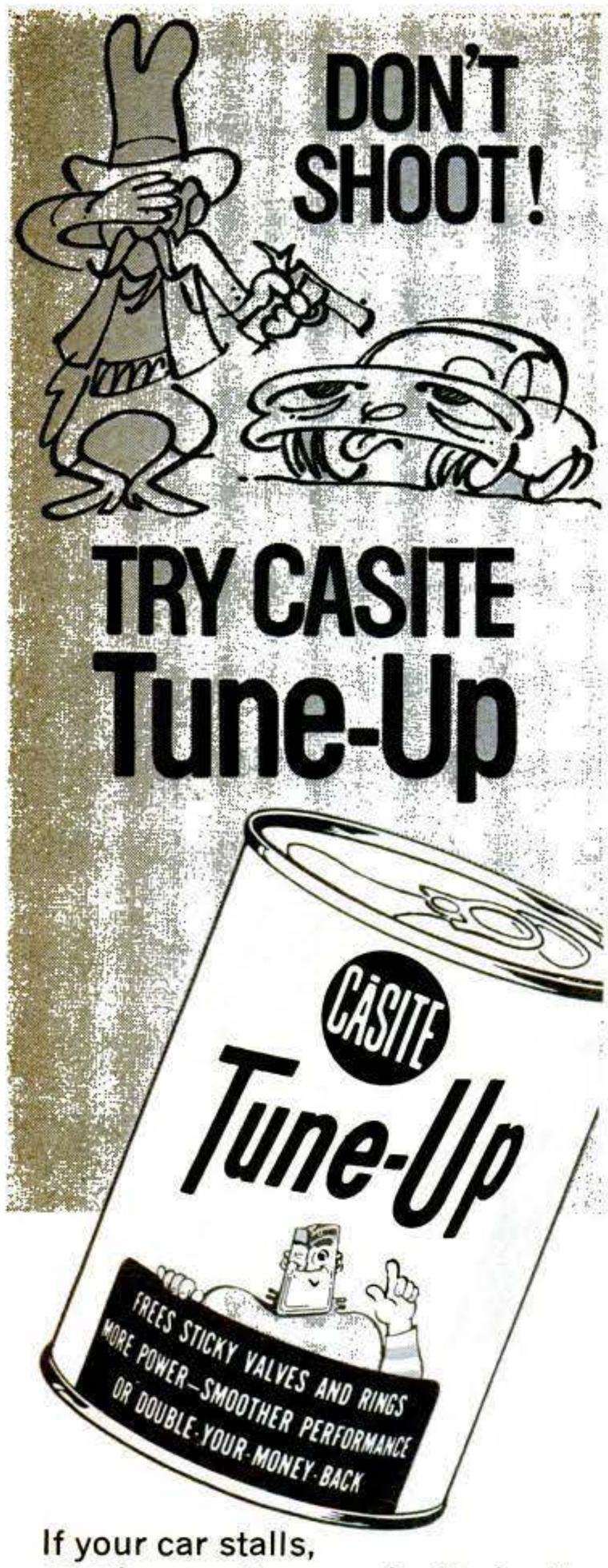

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manual, and no more. The seat-back lock at the base of the seat is hard to reach, and it's difficult to release the lock and push forward the seat back with one hand.

Because the door glass is wider, the rear-quarter window has been eliminated. Camaro's visibility is good in all directions. But the big doors have a drawback in parking: You must swing the door wide open to get in and out of the front seat easily, and you don't always find wide enough parking space. Trunk room is limited. Chevy claims 7.3 cubic feet of useful space, but we found that we could not get two suitcases in at one time. The

Javelin's hood scoop raises hood line and impairs the view. Here, tires are being inflated before car is put through tests.

Barracuda's hood scoops are dummies—just fancy styling without function. Here, the brake pressometer is being fitted.

huge spare wheel steals a lot of room. Under the hood, service accessibility is very tight. You need special tools for the plugs; the coil and distributor are at the rear of the engine; and the oil filter can be removed only from below.

Mustang—Mach I version. In its desire for sportiness, Ford has made it a hot-rod. The car has lots of power. It goes fast, and it handles well on a smooth surface. It proved fastest in the high-speed lane change. But on winding roads with bumps or ripples, the rear wheels have trouble maintaining contact with the road—the axle bounces around, giving the driver more handling problems than would the same car with softer springs. The passenger feels road shocks acutely, and the bodywork suffers from shake and vibration. The engine is so unsteady at idle that it rocks the whole car.

Rear visibility is a critical point. There are serious blind spots on both sides, not because of the "sports slats," as the factory calls the venetian blinds on the back window, but because of long, rear-quarter panels. The slats are horizontal and do not obstruct vision.

Forward visibility suffers from the low seat, long hood, and the high padding on top of the instrument panel. Intermittent wiper action, however, is a plus.

Small controls are set way forward —low down—on the instrument panel. Standard instruments include gas and temp gauges only. The glove box is tiny. Interior finish, however, was uniformly good. There's nothing cheap about the Mach I's upholstery, carpeting, or headliner.

Mustang has the smallest-looking trunk, though Ford claims 7.2 cubic feet for it. It will not hold both the spare wheel and a large suitcase, and

Continued

Collapsible space-saver spare tire adds useful space to Barracuda's trunk. Lift-over height is high, but not unreasonable. Key cylinder is removed from trunk lock itself.

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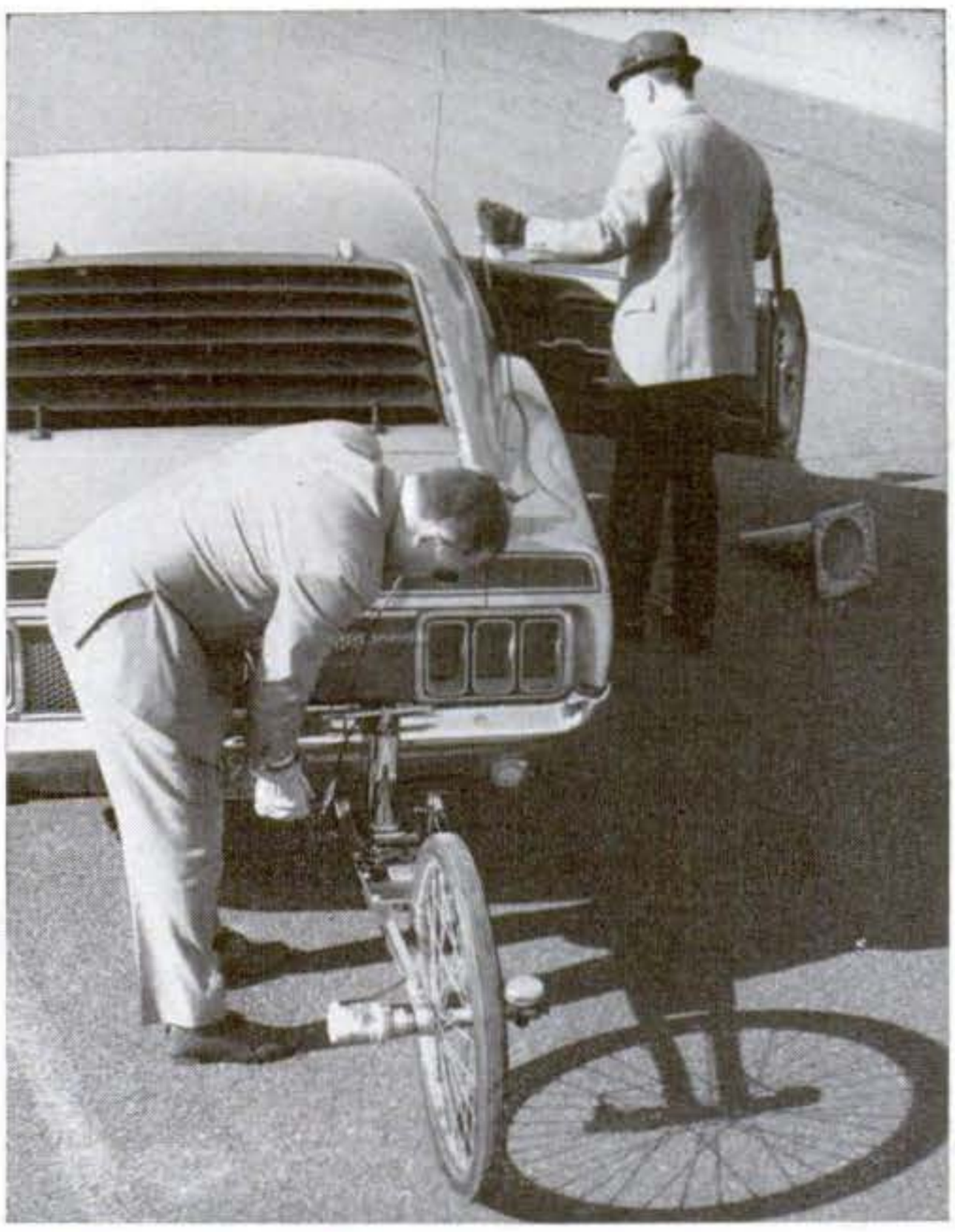
Camaro brakes held up very well during the 10 warmup stops but then faded severely for the final minimum-distance stop, with efficiency never exceeding 91 percent.



Norbye hooks up fifth wheel to the Mustang, while Dunne prepares to install the electric speedometer, prior to the braking and acceleration tests.

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	Camaro	Mustang	Javelin	Barracuda
30 mph (smooth road)	64A	67A	65A	66A
60 mph (smooth road)	71A	77A	76A	75A
30 mph (rough road)	74A	78A	76A	75A

the liftover is unusually high. Extra hood locks, coupled with the dual-action release, mean you have to operate four separate devices to open the hood. The plugs are hard to remove because the spring towers leave little room on the sides of the engine. The distributor, in front of the air cleaner, is easy to reach, and the oil filter is accessible from below.

AMC's Javelin. This one has the roomiest interior and the biggest trunk (10.2 cubic feet). It runs a close second to the Camaro in ride comfort. Visibility is very good, except for a small blind spot in the right rear-quarter panel. But your view of the road ahead would be even better with a small (functional) hood scoop. The black interior is partly relieved by the wood-like applique used on the instrument panel. The gauges include only fuel and temp, in addition to the speedometer.

This car's rim-blow horn control will take some getting used to. The horn blows accidentally, and the driver can't find the horn quickly when needed. The Javelin's variable-ratio steering is helpful in counteracting its basic understeer, but still too slow to enable the car to go faster in the handling tests.

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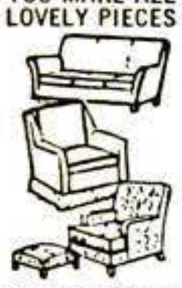

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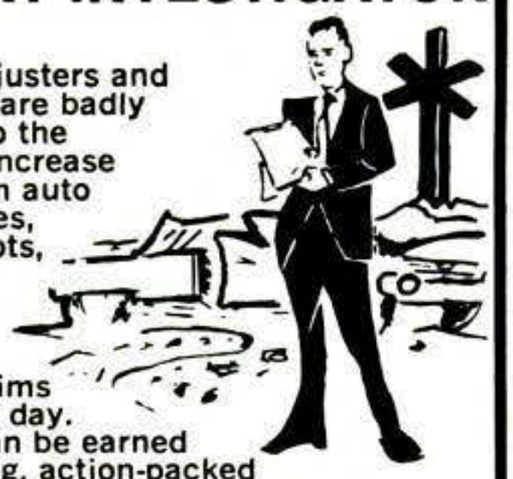

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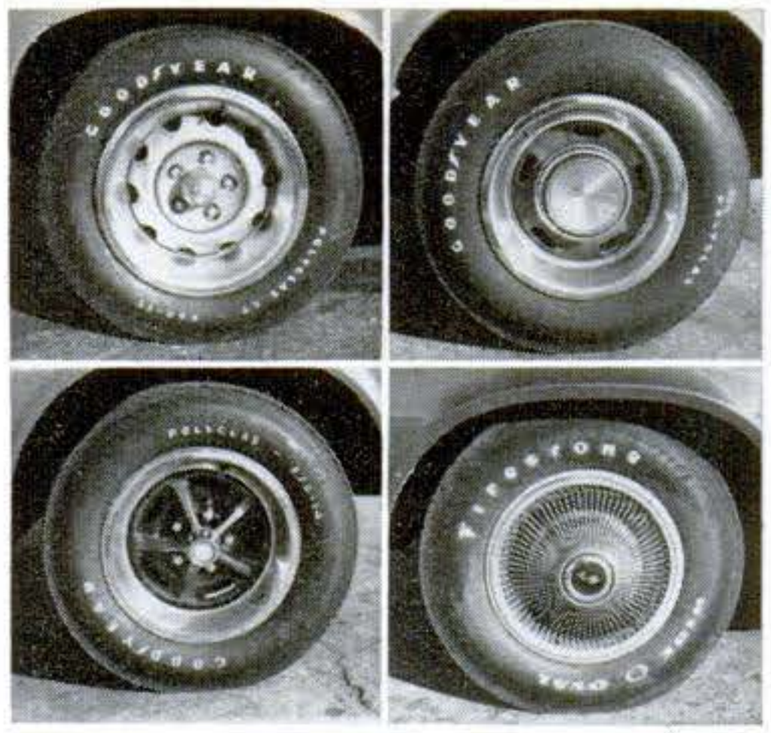

Front bucket seats are split by a cushion and folding armrest. Three handy assist straps are fitted on the doors and instrument panel. The glove compartment is as big as a shoe box.

We found the gearshift lever too far forward in relation to the wheel, having to lean forward to engage first and third. The transmission made considerable gear noise, but the engine was remarkably quiet. It also

Continued

Sporty wheels; top, left to right: Barracuda, Javelin. Below: Mustang, Camaro.

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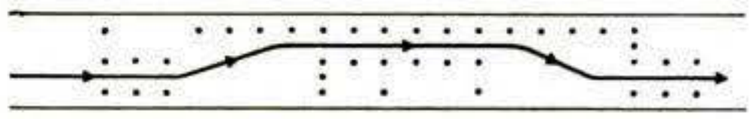
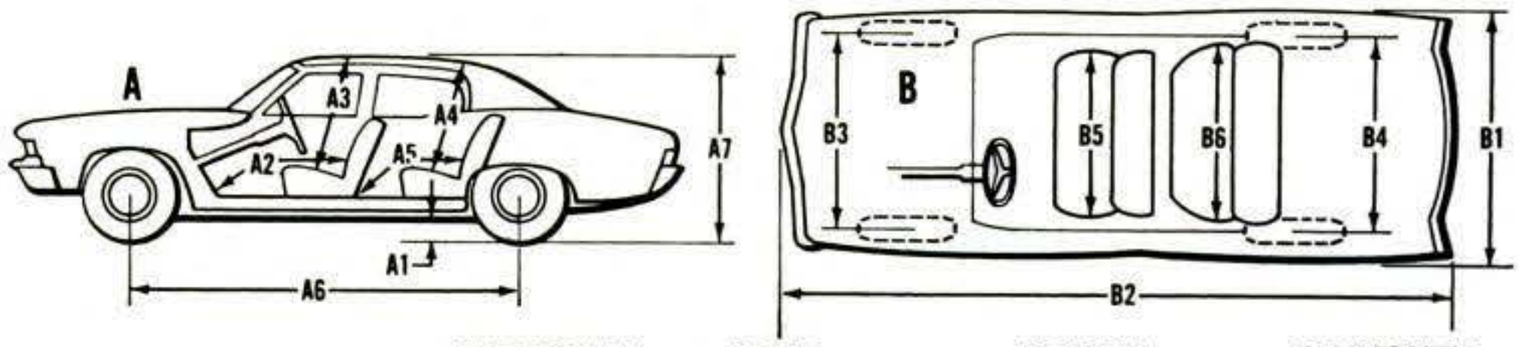


Two lane changes in quick succession show a car's ability to make an emergency maneuver at speed. The lanes are blocked 120 feet apart, and the lane-change gaps are 60 feet long. Each car is put through the test at increasing speed until its maximum has been established.

The low-speed emergency-maneuver test consists of snaking a car as fast as possible through pylons spaced 48 feet apart. In both handling tests, times are clocked by two stopwatches, then converted to mph.



DIMENSIONS (inches)	CHEVROLET Camaro SS	FORD Mustang Mach I	JAVELIN SST	PLYMOUTH Barracuda
A1 Ground clearance	4.5	5.0	6.0	5.2
A2 Front leg room (max.)	43.8	40.1	42.7	42.3
A3 Front head room	37.4	37.3	37.5	37.4
A4 Rear head room	36.1	30.5	36.0	35.7
A5 Rear leg room (min.)	29.6	28.8	31.5	28.9
A6 Wheelbase	108.0	108.0	109.9	108.0
A7 Height	50.5	50.6	51.6	50.9
B1 Width	74.4	71.7	71.9	74.9
B2 Length	188.0	187.4	191.04	186.7
B3 Front track	61.3	58.5	59.1	59.7
B4 Rear track	61.0	58.5	56.6	60.7
B5 Front hip room	56.7	55.6	57.6	57.1
B6 Rear hip room	54.4	40.0	56.4	52.0
SPECIFICATIONS				
Engine type	OHV V8	OHV V8	OHV V8	OHV V8
Bore × stroke	4.00 × 3.48 in	4.00 × 3.50 in.	4.08 × 3.44 in.	4.04 × 3.31 in.
Displacement (cu. in.)	350	351	360	340
Compression ratio	10.25:1	10.7:1	10.0:1	10.5:1
Carburetion	One 4-barrel	One 4-barrel	One 4-barrel	One 4-barrel
Power @rpm	300 @4,800	300 @ 5,400	290 @ 4,800	275 @ 5,000
Torque (lbs.-ft.) @ rpm	380 @3,200	380 @ 3,400	395 @ 3,200	340 @ 3,200
Transmission	4-speed manual	4-speed manual	4-speed manual	4-speed man.
Axle ratio	3.31:1	3.50:1	3.54:1	3.55:1
Tires	Firestone SupR-Belt	Goodyear Polyglas	Goodyear Polyglas	Goodyear Polyglas
Tire size	F70-14	F70-14	E70-14	E60-15
Turning diameter (ft.)	38.86	37.6	36.3	38.7
Turns, lock to lock	2½	4	3¼	3½
Brakes	Disk/Drum	Disk/Drum	Disk/Drum	Disk/Drum
Fuel tank (gal.)	19	22	19	18
Curb weight (lbs.)	3,432	3,406	3,277	3,384
Test Results				
Acceleration 0-60 mph	8.0 sec.	7.4 sec.	6.8 sec.	7.5 sec.
Acceleration 0-80 mph	14.0 sec	12.8 sec.	12.6 sec.	11.4 sec.
Acceleration 25-70 mph	8.15 sec.	7.7 sec.	7.6 sec.	6.9 sec.
Braking distance 60-0 mph	184 ft. 9 in.	161 ft. 6 in.	144 ft. 6 in.	181 ft. 4 in.
Brake pedal pressure (lbs.)	200+	160	50	200
Max. speed—lane change	57.0 mph	57.5 mph	52.2 mph	56 mph
Max. speed—traffic weave	24.8 mph	24.25 mph	20.4 mph	22.7 mph
Average fuel mileage	13.0 mpg	9.6 mpg	10.9 mpg	10.8 mpg
Price (basic)	$2,996	$3,271	$2,848	$3,164
Price (as tested)	$4,118	$4,178	$3,963	$4,092

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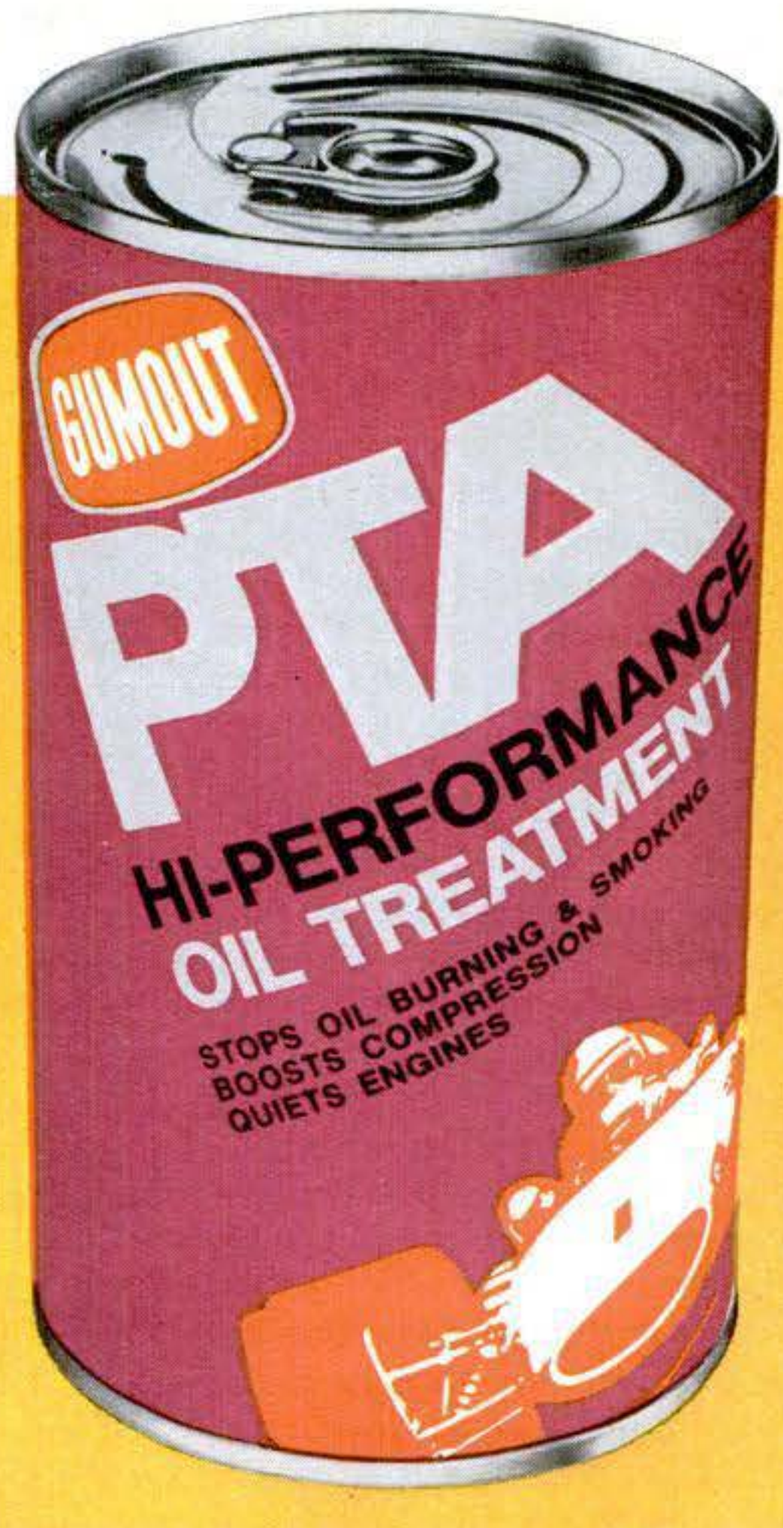
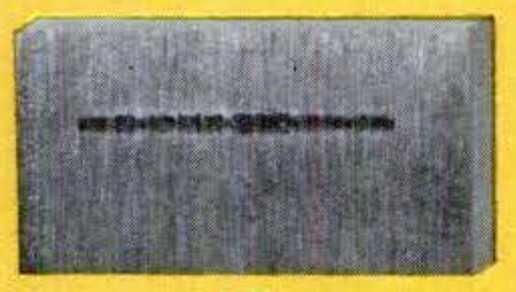
New from the makers of GUMOUT . . .

PTA

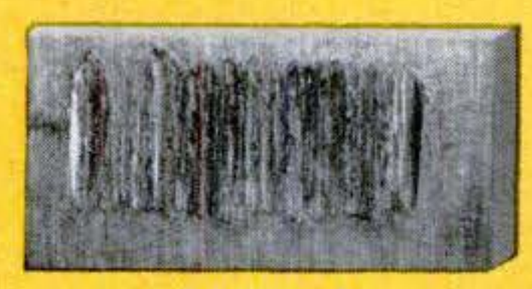
HI-PERFORMANCE OIL TREATMENT



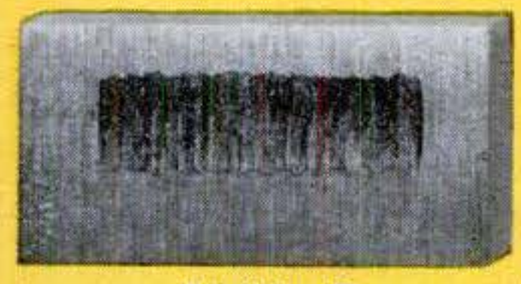
This revolutionary, multi-purpose oil improver sets new high performance standards for all other oil additives. PTA stops oil burning, increases compression, reduces exhaust smoke, and quiets noisy engines. It does all these things with superior efficiency. But it does much more! Here's the story and . . . HERE'S THE PROOF!



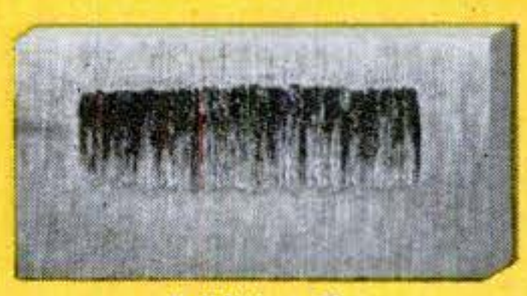
PTA



Additive A



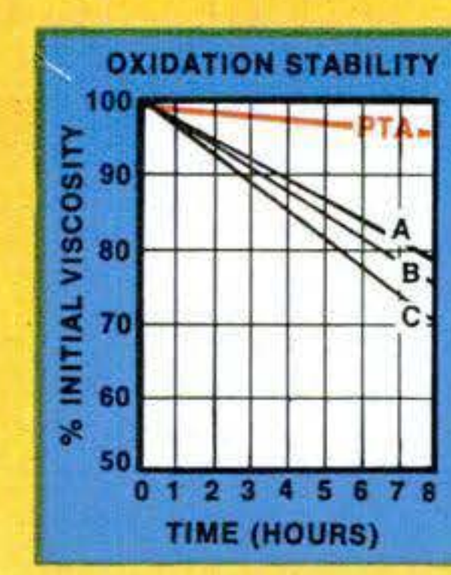
Additive B



Additive C

These four steel blocks have been subjected to identical test conditions to determine the load bearing limits of the four leading oil additives. During this standard film strength test a hardened steel roller was rotated against a steel block at a constant pressure. All blocks were tested for the same length of time and with the same amount of lubricant. Note the small wear scar on the PTA lubricated block—and the severe scoring on the other blocks. *Proof* that PTA maintains its lubricity after other additives lose theirs.

HERE'S WHAT PTA WILL DO FOR YOUR CAR—As engines begin to wear, even the best motor oil can drain away from vital areas and be unavailable when needed most—at start up. PTA treated oil clings to these areas and provides instant lubrication. This means easier starting, less wear and a quieter engine. In older cars PTA reduces the blow-by which occurs with worn piston rings. You'll get increased power, improved mileage, less oil burning and less smoke.



Here's more proof!

All additives will eventually oxidize and break down under high heat and agitation. This test chart shows how the oxidation stability of PTA compares to other leading additives when tested under identical conditions.

PTA DELIVERS THESE EXTRA BENEFITS—Multi-purpose PTA contains a unique dispersant that holds dirt in suspension, keeping engines clean and valve lifters free. An oxidation inhibitor is also included to retard the formation of sludge. As a result, PTA lasts longer than other additives.

A can of PTA added to your oil will provide vitally needed extra protection and do it more effectively than any other leading additive. ASK for PTA at your auto supply store or wherever fine auto products are sold. Prove to yourself that it really works better.

GUMOUT PENNSYLVANIA REFINING COMPANY, CLEVELAND, OHIO 44104

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has terrific torque, and the Javelin was quickest from 0 to 60 mph.

The distributor is mounted up front in an accessible position, and all plugs could be reached, except the front plug on the right bank, which was hidden by an air preheat duct. Access to the oil filter is blocked by steering arms below, engine above.

Plymouth's 'Cuda 340. The Barracuda looks and feels more like an intermediate than a compact. It is the widest car in the group and appears bigger inside, though it isn't. The interior is all black. Head restraints are integral with the front seat backs. Ride comfort? Only a little better than the Mustang's. The car gets skittish on poor road surfaces. Instrumentation was complete, with a tachometer plus gauges for heat, alternator, and oil pressure. The small controls were well arranged and had varied shapes for touch recognition. The power steering is fast and feather-light, but has a rather numb feel, making it difficult for the driver to know how much of the car's cornering ability he is using.

On fast turns, fuel starvation tells the 'Cuda driver how hard he is driving. The engine loses power as the gas in the float chamber is thrown up one side, closing off the fuel supply. The engine recovers as soon as the car is again aimed in a straight path.

In the low-speed traffic weave, speeds in our test were kept down by pump catch. The power-steering pump gets confused by rapid steering reversals. When that happens, the steering seems to lock solid for a moment before power assist is restored.

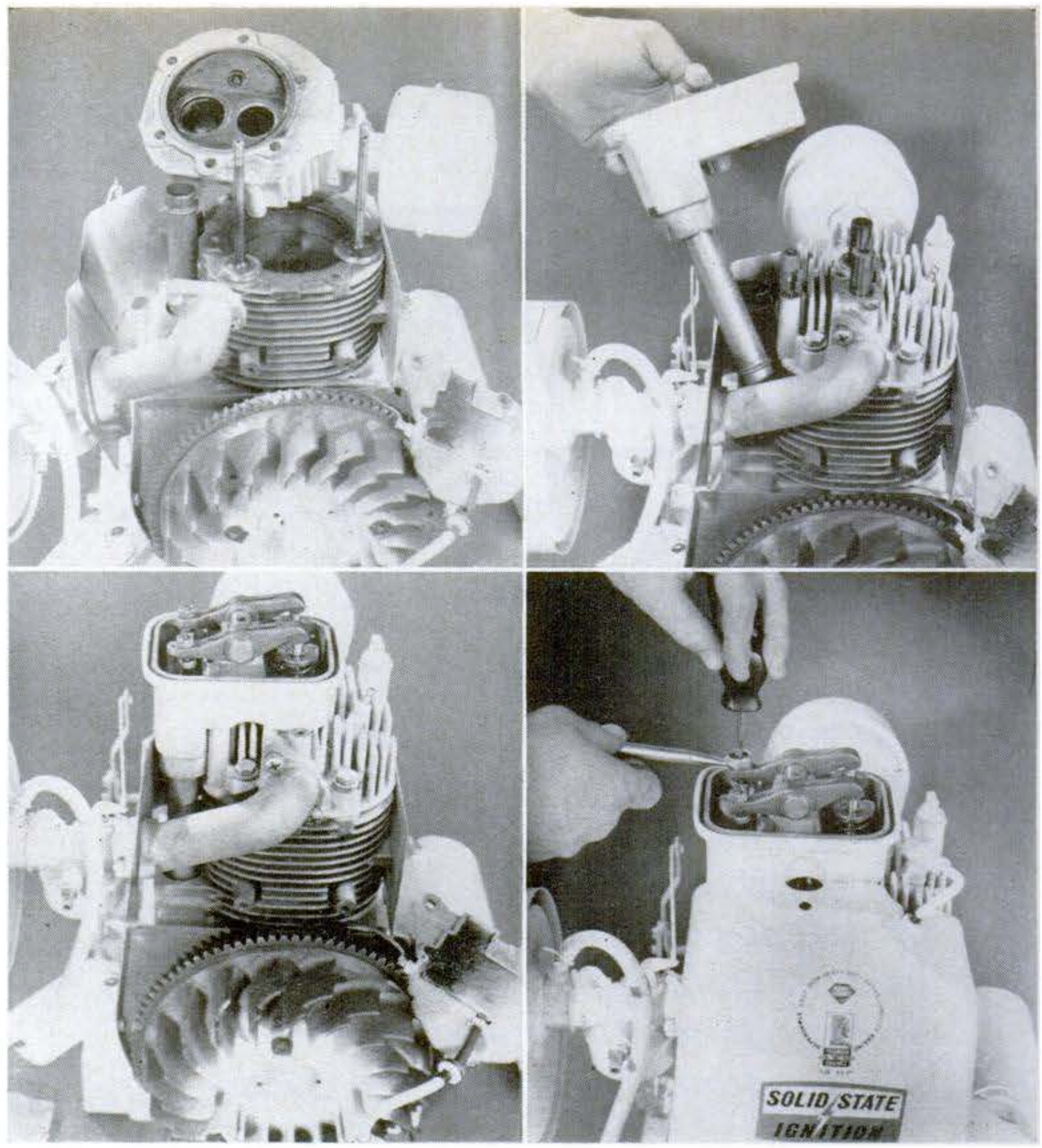
Chrysler claims only 5.9 cubic feet of useful trunk space, but the 'Cuda's trunk has a very practical shape and will hold two suitcases with ease. The hood is held in place by four separate locks. Under the hood, you'll find the plugs easy to get at, the distributor (behind the air cleaner) difficult. The oil filter is accessible from above. In power, the engine was amazing. It had the lowest displacement of all cars in this group, yet gave fastest acceleration from 0 to 80 mph and from 25 to 70 mph.

Personal cars. More than any other type of car, these vehicles are often reflections of the owner's personality. There are subtle differences in character between all of them, and only you can make your choice.

Conclusions

Dunne: I prefer the Camaro. It's a high-performance car I'm comfortable in, and the handling is first-class.

Norbye: I love the steering on the Camaro but was disappointed in the brakes. Still, it's my choice, too. I'm impressed with its overall performance, quality, and finish. PS



One-Cylinder Engine Boasts Overhead Valves

It's a new, compact, lightweight, air-cooled, single-cylinder, 27.66 cubic-inch, 14-hp engine. And it promises to satisfy the power hunger of many lawn- and garden-tractor buyers. Recently introduced by Tecumseh under the name of HH-140, this overhead-valve one-lunger is unique on the American scene today.

Power ranges from 7.70 hp at 1,800 rpm to 14 hp at 3,600. It has a maximum torque of 24 pound-feet over a pretty wide span of the curve, from 2,400 to 2,800 rpm, and cranks out a healthy 20.58 pound-feet even in the 1,500- to 1,600-rpm range.

Translated into what it can do for you, this means the engine can lug high loads at low speed without pooping out when you need power most. It also means you can chug along at low throttle on those jobs where you want to be especially cautious.

I think this is the first of a whole new generation of gutty small engines for outdoor power equipment.

Take a look at the pictures above. Top, left, shows the cylinder head pulled and placed upside down on the cylinder. The big valves are a tipoff of efficient breathing, and the compact combustion chambers signify effective use of the fuel energy. These contribute most to the unit's high output.

Top, right, a mechanic is fitting the valve-train container—the tube holds the pushrods, and the box holds the rocker shaft and arms.

Below, left, the valve gear is installed, with the rocker cover still off.

Below, right, the mechanic is adjusting the valve clearance. The cooling fan is part of the flywheel (below, left). The last photo shows the ducting installed, to direct air over the head and cylinder.

Capacitor-discharge ignition is standard. A Dyna-Static balancing system with gear-driven counterweights is a much-recommended option (although it has not been fitted on this unit). —*E. F. Lindsley*

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Catch fifth gear! Grab the throttle! It's a whole new way to leave the humdrum behind.

The new twin 90 HS-1 is something unique. It's a 196-pound lightweight that's put together like the big bikes. The same look, the same feel. And it's all there: five-speed gearbox, Autolube oil injection, separate instruments and an urge to travel.

So escape for a while on the HS-1, shown below and on the left, above. Or the four-speed, 170-pound, 73 cc G6-S, also shown above. Both have 4.9 horsepower. Both have what it takes to turn any old day into an adventure.

Yamaha International Corporation
P.O. Box 54540, Los Angeles, Calif. 90054
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It's a better machine

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r new fishing motors, the 9½, 6, 4 d 1½ hp, all have the same Johnson ependability as Mr. Chenoweth's 1938 ea-Horse. They also have the benefit f 32 more years of improvements in engine performance, hydro-dynamic design, fuel economy and corrosion resistance. We're so sure of them, we back every Sea-Horse from the 1½ up to the 115 hp with an exclusive 2 year warranty*. That's a lot of warranty. But then, a Johnson is a lot of outboard. Right, Mr. Chenoweth?

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Johnson Outboard Motor Co.
Waukegan Ill.

Dear Sirs:

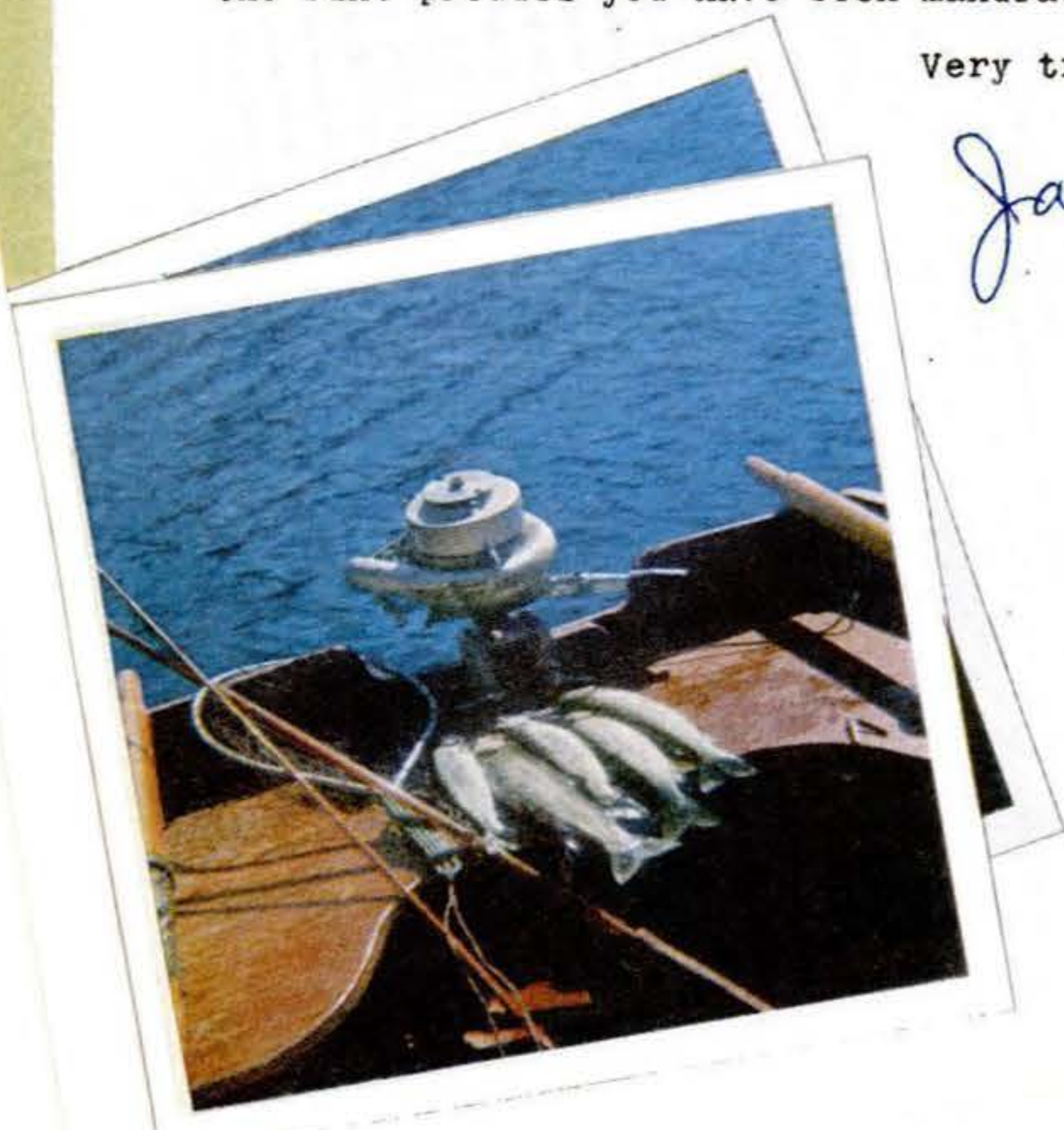
Enclosed are two snapshots of a Johnson MS-38; wired togehter, welded togehter, mended with epoxy, thirty one years old and still catching fish.

It is phenominal the dependability of a Johnsin regardless of age. I have been using outboard motors for thirty eight years and have owned nothing but Johnsons. I have never had to row in because of motor failure.

I hope that a great part of the outboard world appreciates as I do the fine product you have been manufacturing all these years.

Very truly yours,

Jay Chenoweth



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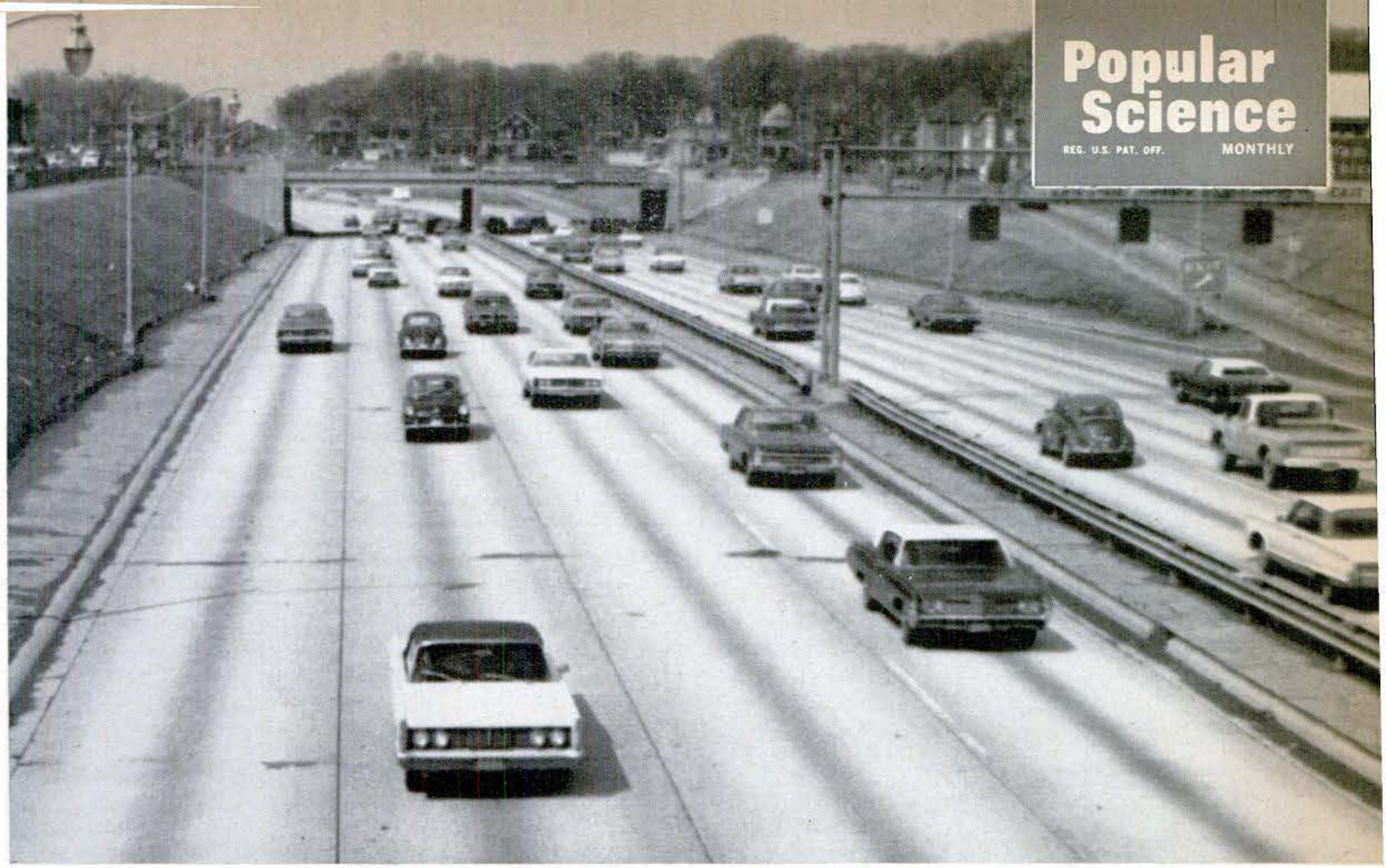


Ford's research shows that automobiles spew 50 pounds of lead every day on each mile of Detroit's freeways.

Getting the Lead Out of Gas—

How It Will Affect You and Your Car

Lead-free fuels promise to end lead-compound exhaust emissions—but they have many strange side effects

By **JAN P. NORBYE** / *PS Automotive Editor* and **JIM DUNNE** / *PS Detroit Editor*

Last February, GM announced that all '71-model GM cars would be built to run on 91-octane unleaded gasoline. The other auto makers followed suit. Ford said that nine out of 10 Ford engines would be ready for 91-octane gasoline in October, the rest within the '71 model year. Chrysler said seven out of 10 of their engines have low-octane capability now, and 9.3 out of 10 would have it when the '71 models go into production.

The additive generally called lead is really tetraethyl lead, plus scavenging agents such as ethylene dibromide, which are necessary to allow the use of lead in the first place. What good is lead? It raises the antiknock properties of the gasoline [PS, June '68].

The only lead-free gas on the market when the decisions to remove lead were made was Amoco Premium, rated at 99 octane and retailing in 26 states at up to 44 cents a gallon. Clearly, Detroit had challenged the petroleum industry. Within a month, 14 oil companies announced they would produce an unleaded 91-octane gas later this year. They were American, Atlantic Richfield, Chevron, Citgo, Clark, Getty, Gulf, Humble, Marathon, Phillips, Shell, Skelly, Sohio, and Union.

What they and the auto industry now are calling lead-free gas, however, is not 100 percent unleaded. Today's 93-94 octane regular (and higher-octane premium) gasoline contains 2.5 to 3.0 cubic centimeters of lead (by which is meant tetraethyl-lead additive) per gallon. The 91-octane fuel will have its lead content cut to 0.5cc per gallon—considered *virtually* lead-free. This residual amount of lead is judged tolerable by the auto industry for next year's engines. But whether it can be labeled unleaded is doubtful.

What the fuss is all about: E. E. Nelson of GM contrasts a gallon can of gasoline with a vial holding its lead additive—three cubic centimeters of tetraethyl lead.

Why the furor over leaded gas? President Nixon told Congress that, as part of the Government's growing

Getting rid of the lead in your automobile's diet may double spark-plug and

Chrysler's Moeller shows old (left) and new pistons for 440-cube V8. New type has saucer-shaped crown to lower compression ratio. Head cavities are also changed.

efforts to stop air pollution, the use of lead in gasoline must end by 1972. Donald F. Adams, head of the air-pollution section of the Washington State University's College of Engineering, explained the problem: "We are putting the equivalent of 100,000 tons of lead into the air each year. This is a known poison."

Lead pollution of the atmosphere is only one of the problems. Detroit also blames lead for engine deposits that raise emission levels and cause deterioration of present emission-control systems. Leaded fuel may become a barrier to the creation of future control systems.

So far, it all seems simple enough. If lead is bad, then stop using it, you might say. Cars don't *need* leaded gas. It's true that some need more knock resistance, and adding lead is the cheapest way of improving the octane rating. But adding lead isn't the only way; Amoco has proved that.

The condemnation of lead is by no means unanimous. Lawrence E. Blanchard Jr., executive V-P of the Ethyl Corp., has this to say: "There is no proof that lead in the atmosphere creates any health hazard to the public." Mobil Oil's Dr. Dayton H. Clewell told us: "Lead is not necessarily harmful. It is not a pollutant if it participates in the combustion process. It's only what comes out of the tailpipe that counts."

We asked Edwin E. Nelson, GM staff engineer in charge of emission control, what happens to the lead inside the engine. He said that 75 percent of the lead leaves the engine in the form of particulates, not in a gaseous state. These particulates are small enough to stay suspended in the air to be inhaled by you. Some lead stays in the engine in the form of deposits; other minute amounts are trapped in the exhaust system.

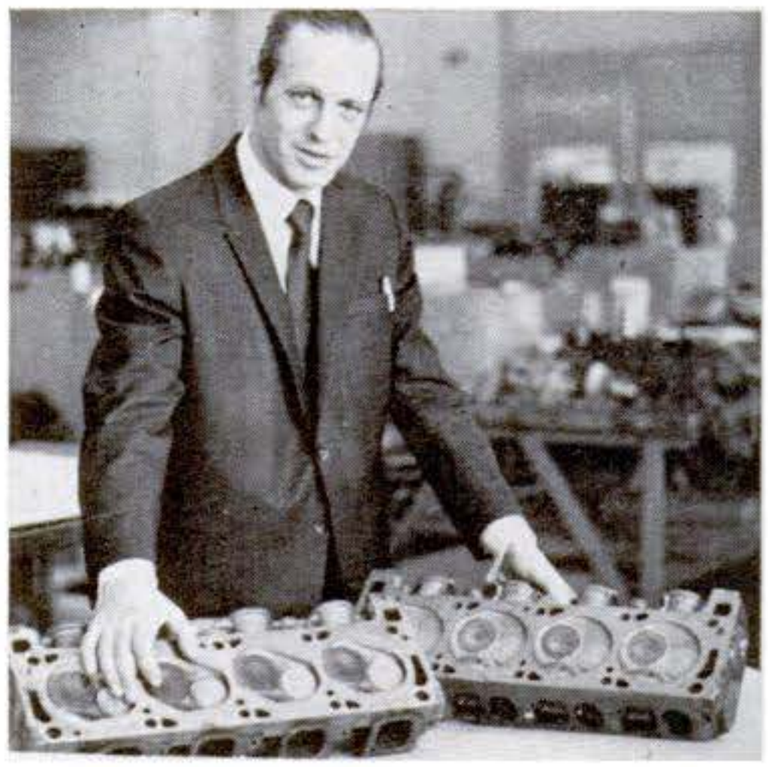
But Ethyl, which along with Du Pont dominates the lead-for-gasoline market (other suppliers are Houston Chemical and Nalco) has more to say. Ethyl experts maintain that only one-third of the suspended particulates are lead or lead compounds. Another third is carbon, and the rest is as yet unidentified, they insist.

When GM says that "the only way we know to get the particulates out of the exhaust is to get the lead out of the gasoline," the corporation is ignoring particulate traps as developed by Ethyl, Illinois Institute of Technology, and North American Rockwell. Ethyl claims to have a cyclone-type device that cuts lead particulate emissions by 65 percent, yet is comparable to a standard muffler in size, cost, complexity, back pressure, and durability.

Ethyl's V-P Blanchard quoted from a report by the U.S. Bureau of Mines, stating that removing the lead from the gas could actually increase smog-producing emissions: "The fuel alterations *from* leaded *to* unleaded gas changed emission characteristics so that the pollution effect was increased by as much as 25 percent." Ford's findings (see graphs) flatly contradict this. Hydrocarbon emissions invariably diminished when Ford's test cars switched to unleaded fuel.

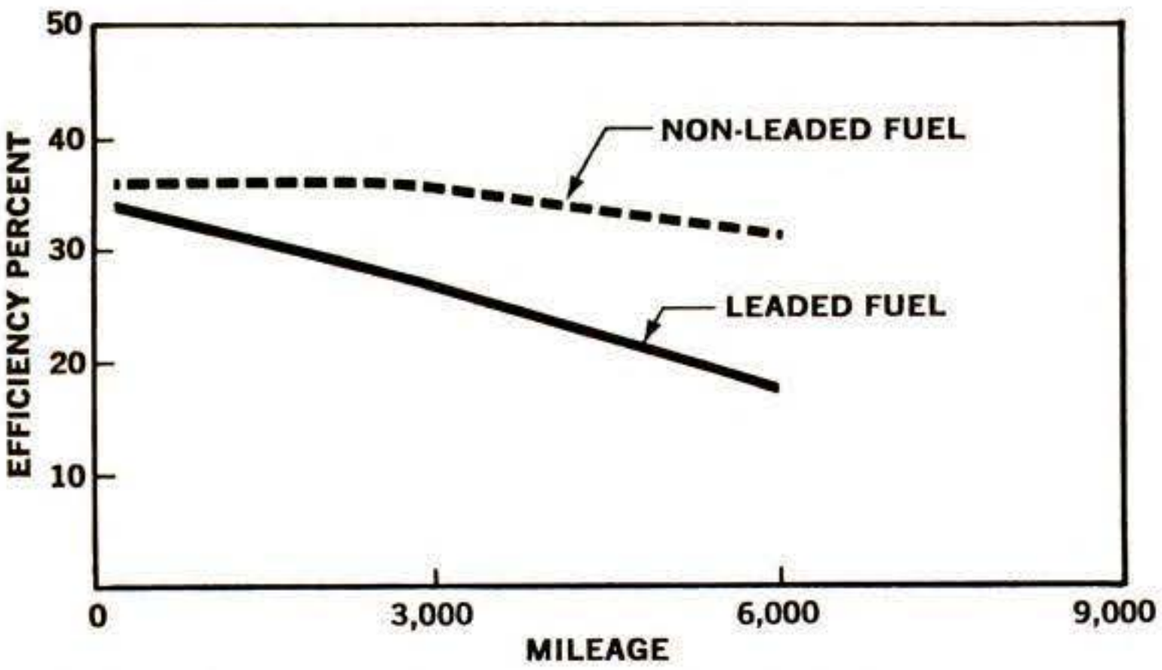
Side effects of lead. Chrysler finds lead to be a culprit in another way. Engines lose from five to seven percent of their power in their first 20,000 miles because of lead deposits. Deposits not only interfere with efficient combustion, but also preheat the air-fuel mixture, thus taking the zap out of the power stroke.

On the other hand, Steve Malone, chief engineer of Pontiac, points out

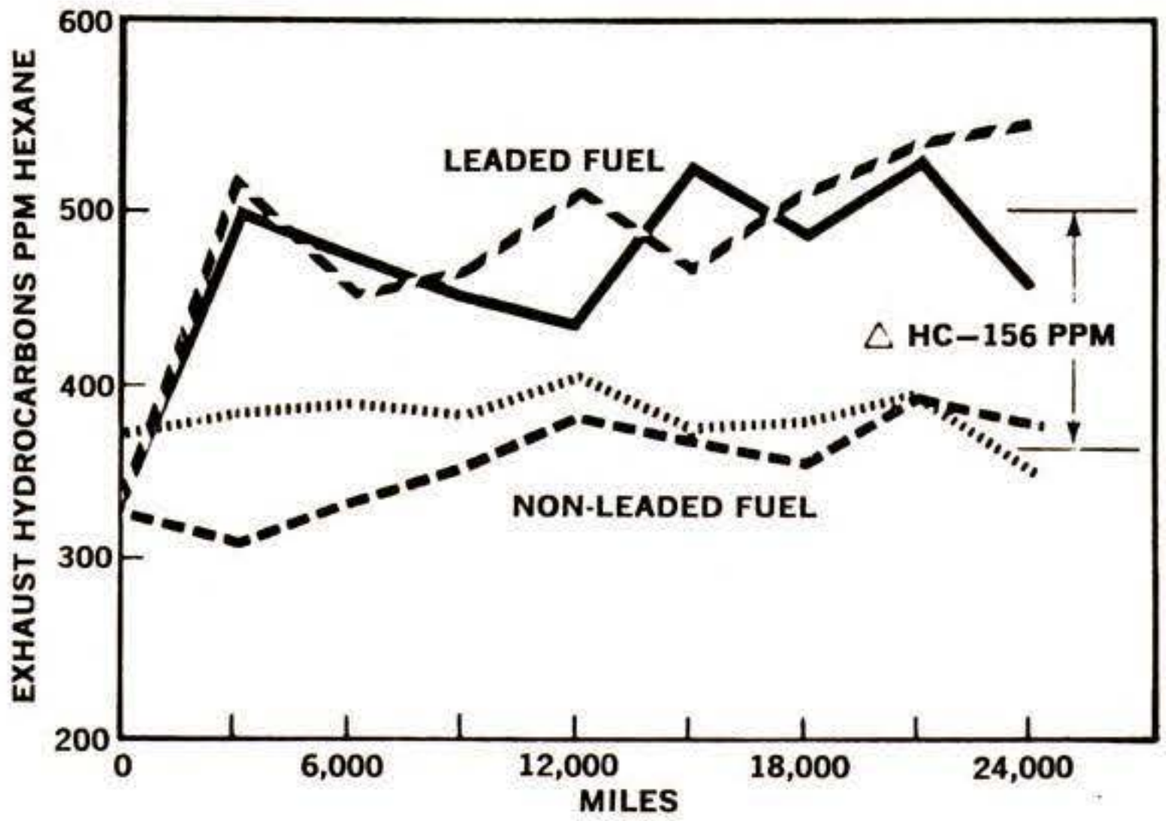


Ford's Bill Gay holds new (left) and old cylinder heads for 351 Cleveland engine. Combustion chamber is now deeper; non-circular, it follows valve-head contours.

What happens to your exhaust gas when you stop using leaded gasoline



Emission-control systems maintain higher efficiency with non-leaded fuel (dotted line) than with leaded fuel (solid line). Test—over 6,000 miles—used two Galaxies with 302-cu.-in. V8s.



On 24,000-mile tests, Ford found hydrocarbon emissions almost doubled as lead deposits accumulated in two cars using leaded gas. Emissions from two cars with lead-free gas varied little.

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muffler life, and stretch oil-change intervals

that lead acts as an insulator between the exhaust valves and the valve seats. Without lead in the gas, tiny areas of wear are caused by friction-welding of valve heads to seats.

Pontiac has two possible solutions in the works: use of dual valve springs, wound in opposite directions, to keep valves from rotating; and fitting a high-hardness valve-seat insert. Neither measure will be necessary, says Malone, if the engine can rely on getting *some* lead, even if no more than 0.5cc per gallon.

GM's E. E. Nelson and Chrysler's E. G. Moeller agree that the oil-change interval could be extended, perhaps doubled, by using lead-free gas. Both see a promise of double the life of present mufflers, and Nelson thinks spark-plug life would double.

If future emission-control systems are going to use thermal reactors, catalytic converters, and exhaust-gas recirculation [PS, Apr.], the presence of lead in the fuel will be a threat to the new devices. Worst affected are the catalysts.

Ford's chief engine engineer, Bill Gay, told us: "The lead particles coat each catalyst we have developed, shortening its life dramatically. Our tests show that catalysts can be expected to lose half their original efficiency in 7,500 miles with leaded fuel, compared to 33,000 miles with lead-free gas."

Even thermal reactors are susceptible to attack from the lead-additive scavengers, such as chlorine and bromine, Ford says.

However, Du Pont has developed a reactor that is claimed to give satisfactory long-mileage service using leaded gasoline, and Ford's latest IIEC reactor [PS, Apr.] is designed for leaded fuels.

Next year's engines. Lower compression ratios will mean slightly less efficient combustion, a small loss of power, and, at least theoretically, rising fuel consumption. Says Ford's Bill Gay: "We will drop to 9:1. That's quite a bit down from the 10, 10.5, and 11 that we now offer." Chrysler figures on a three percent drop in power and a similar rise in fuel consumption. Steve Malone of Pontiac puts it in performance terms: "Zero-to-60 times will go up about 0.3 of a second. Fuel economy will go down an average of one-tenth of a mile per gallon. You probably won't even notice the difference." John DeLorean, general manager of Chevrolet, agrees that for the average driver the changes will make little difference.

But Ethyl warns that carbon monoxide emissions will increase.

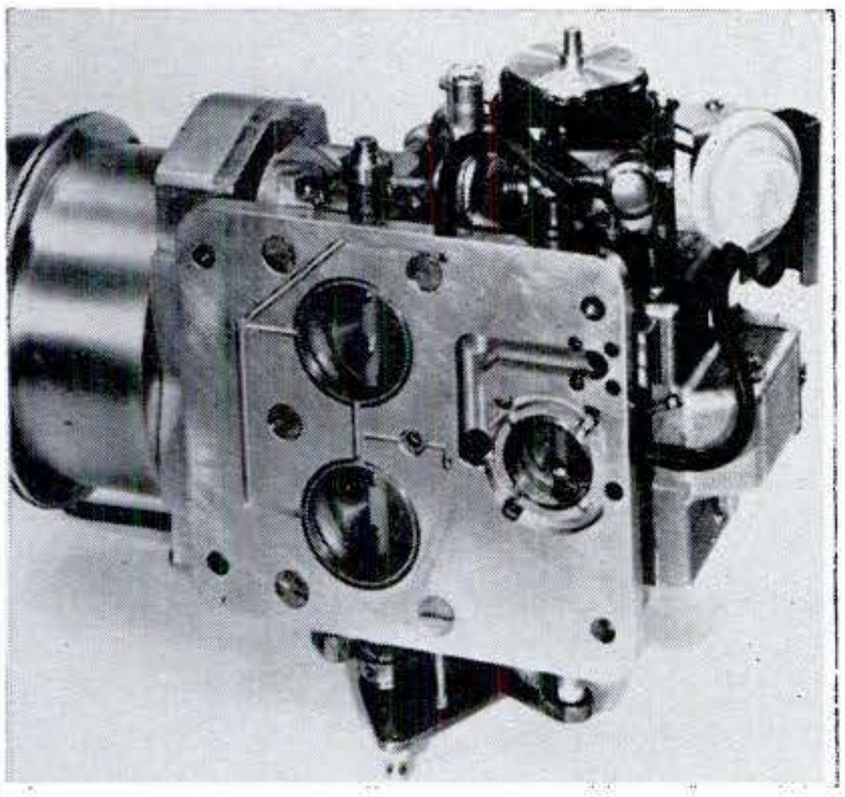
On the other hand, there is no doubt that hydrocarbon and oxides of nitrogen emissions will be further reduced. Lower compression ratios mean reduced burning temperatures, which lowers NO_X content in the exhaust. Hydrocarbon emissions will be reduced because lower compression will not pack raw fuel into every nook and cranny of the combustion chamber where it would escape ignition.

What about the cost? The companies hint at a price level two to four cents above today's regular fuels for the new 91-octane lead-free gasoline. In April, Texaco began marketing 91-octane, unleaded gas in California at four cents above its regular gas price in that state.

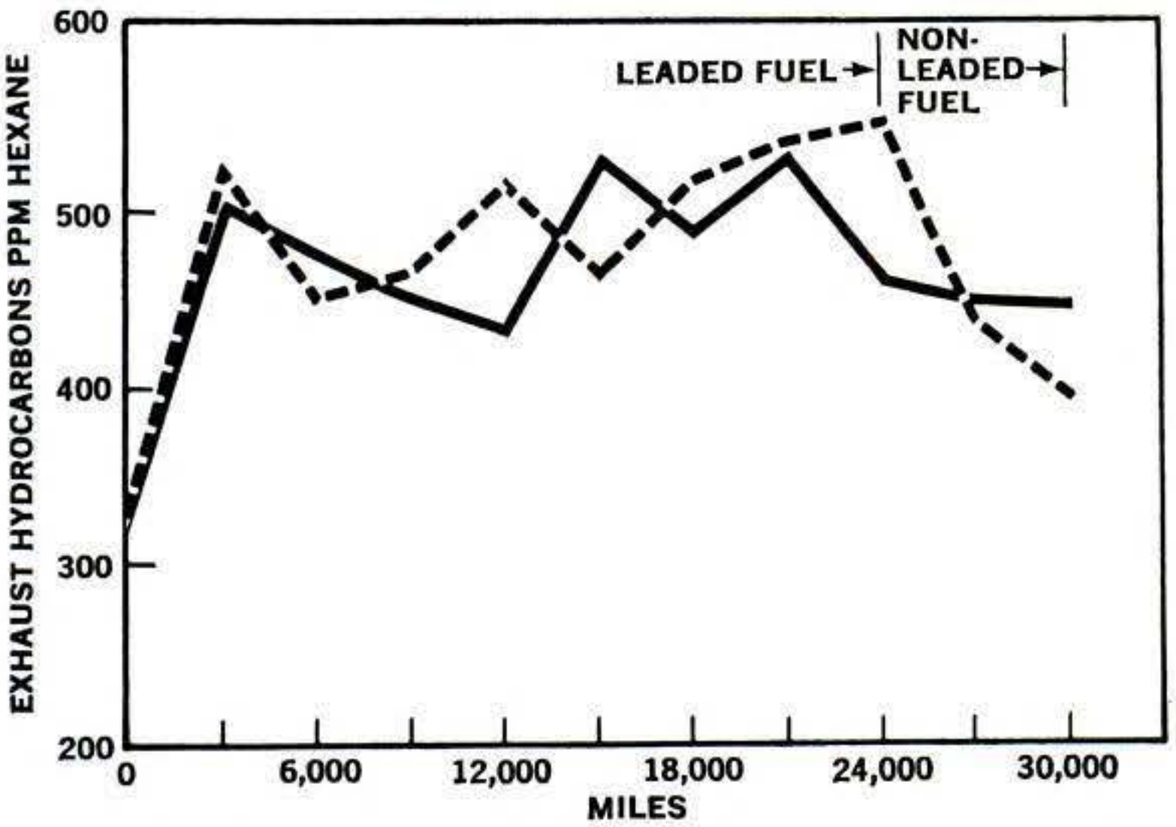
How will you buy it? Gas stations will add a new pump. Leaded regular and leaded premium will stay on sale.

Can you use the new lead-free gas in your old car? If you're using regular fuel now, you should be able to switch without problems. PS

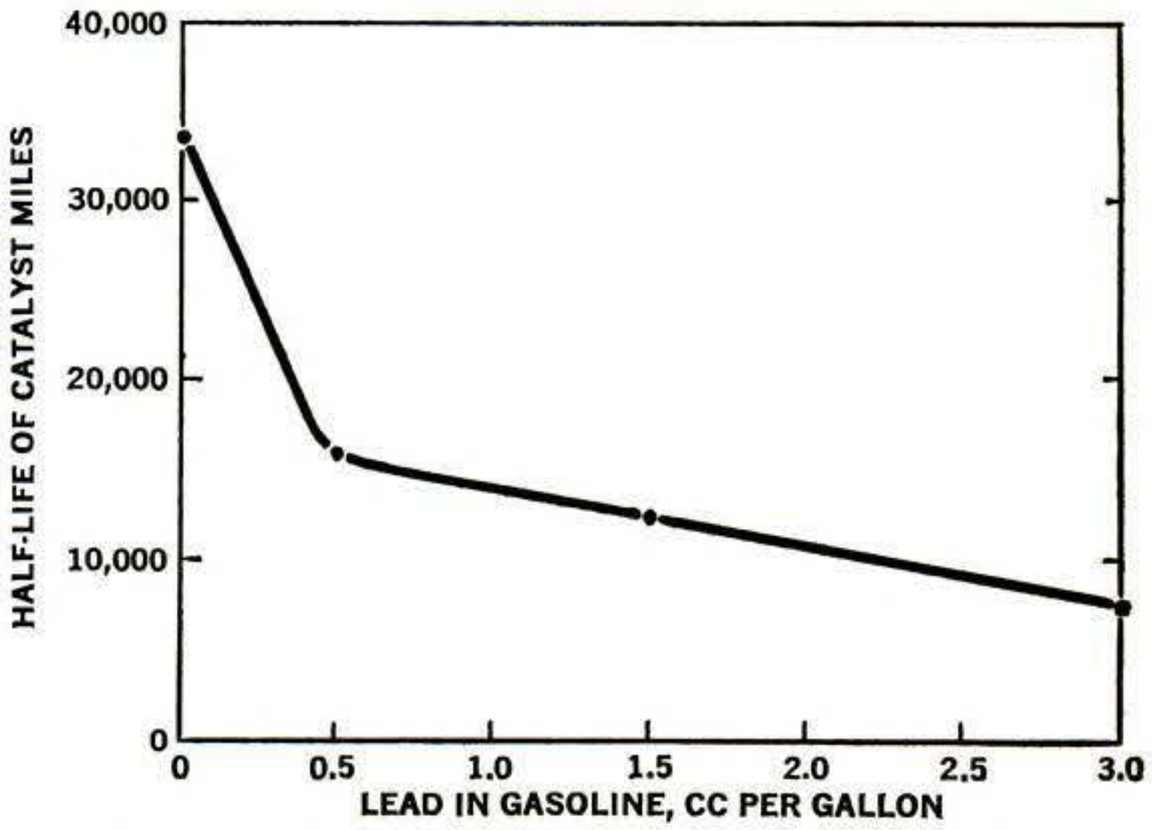
Pontiac's Malone points to valve in '71 cylinder head, with combustion chamber dome raised higher in roof. To make this change, water jacket had to be raised also.



Ethyl's lean-mixture carburetor for leaded fuel has a very small primary throat for high gas velocity at low engine speed. Two secondaries are used for high-load running.



After 24,000 miles, the two cars that had always run with leaded gas were switched to lead-free gas. One showed a sharp drop in hydrocarbon emissions, the other changed less.



Lead content kills the efficiency of catalytic converters; more lead kills quicker. The new, so-called "lead-free" gas will reduce catalyst efficiency by as much as 50 percent in 16,000 miles.

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RCA's New Multiscreen TV Lets You Switch to

With four black-and-white monitors and a 25-inch color screen, this television set of the future doesn't miss a trick—or a channel

By **ARTHUR FISHER** / *Group Editor, Science and Engineering*

The strange television set you are looking at will probably have a lot to do with the kind of set you'll be able to buy in the future, even though it is not for sale.

I first saw it in a top-secret room of an RCA plant in Indianapolis, Ind. There it sat, a 6½-foot-long box of smoky Plexiglas wrapped around five TV screens and some mighty fancy electronics. It was being readied for a smash unveiling before a meeting of distributors, but not as an item they could ever offer to the public. Then why was it built?

Wayne Evans, project engineer of the multiscreen set, explained that its design actually constituted an "engineering feasibility study." The question to be answered: If we wanted to build a no-holds-barred first version of a television and information center, using the latest technology, what would we get?

The answer was the one-of-a-kind set you see here, one that would let you, the viewer, keep an eye on everything going and then switch to where the action is. But how?

The set has four black-and-white monitor screens. Three are preset to the network (or any three VHF) channels in the area. The fourth screen shows another local station, or can be set to scan all other available channels, changing views once every few seconds. On command from a remote-control unit, which is keyed to the electronic heart of the set, the big (25-inch diagonal) main viewing screen—in color—picks up the program displayed on any of the four monochrome screens or displays UHF automatically.

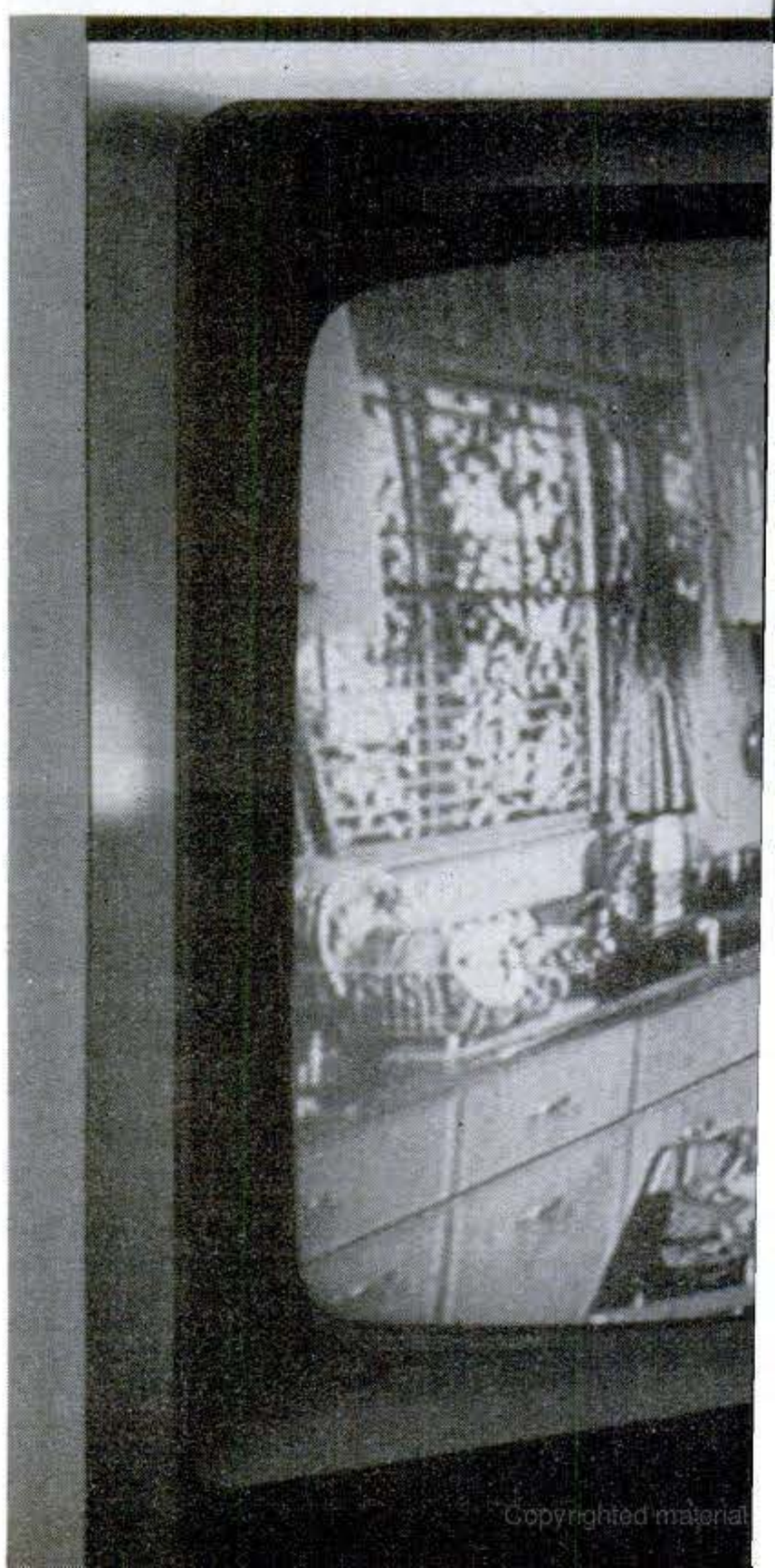
The solid-state control circuits include both digital logic circuits for channel selection and switching, and analog memory modules for loudness, tint, and color. Use of these components means that all functions are electronically silent: There are no motors in the set except for one which, on command, sweeps the tuner through the 70 channels of the UHF band in less than six seconds. (UHF channel indication is digital, and thus highly accurate.) Mr. Evans and a colleague, engineering technologist Don Christensen, told me that much of the circuitry was adapted from the limited-run RCA-2000, a set that marked the first appearance of computer-type, logic circuit electronics in home entertainment equipment.

RCA's multiscreen has four monochrome monitors—three cover the major networks and the fourth can be set to scan any other stations you can pick up in your area.

Remote-control unit does everything—it selects channels, adjusts color and volume, turns set on and off, and also activates high-speed UHF signal-seeking system.

The set also embodies materials innovations that may show up in your set one day. T. P. Madawick, an RCA VP of Industrial Design Consumer Electronics, told how problems that arose in working with thick sheets of Plexiglas, chosen for its transparency, were finally solved with the help of Plexiglas manufacturer Rohm and Haas. And the sleeve that anchors the big color screen in place is a cast fiberglass yoke. This represents a materials breakthrough.

As an added fillip for the viewer who wants to keep posted on everything, two digital readouts constantly display the time and temperature. But you could adapt these features (in a set of the future) to your own special needs—for news, say, or stock quotations. You could rig a meter to tell you the pollution index. And if you had hay fever, you could even get the pollen count.



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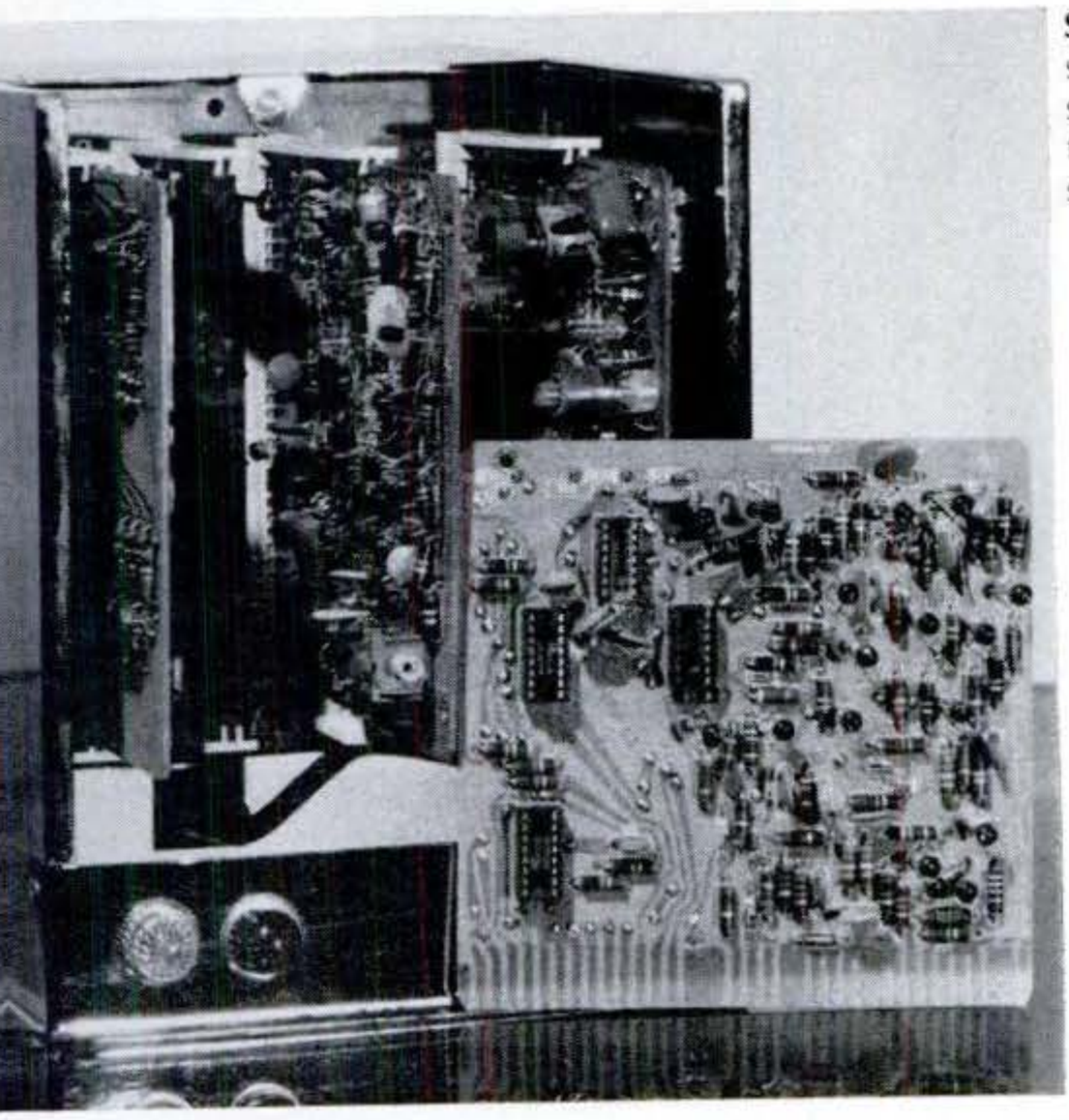
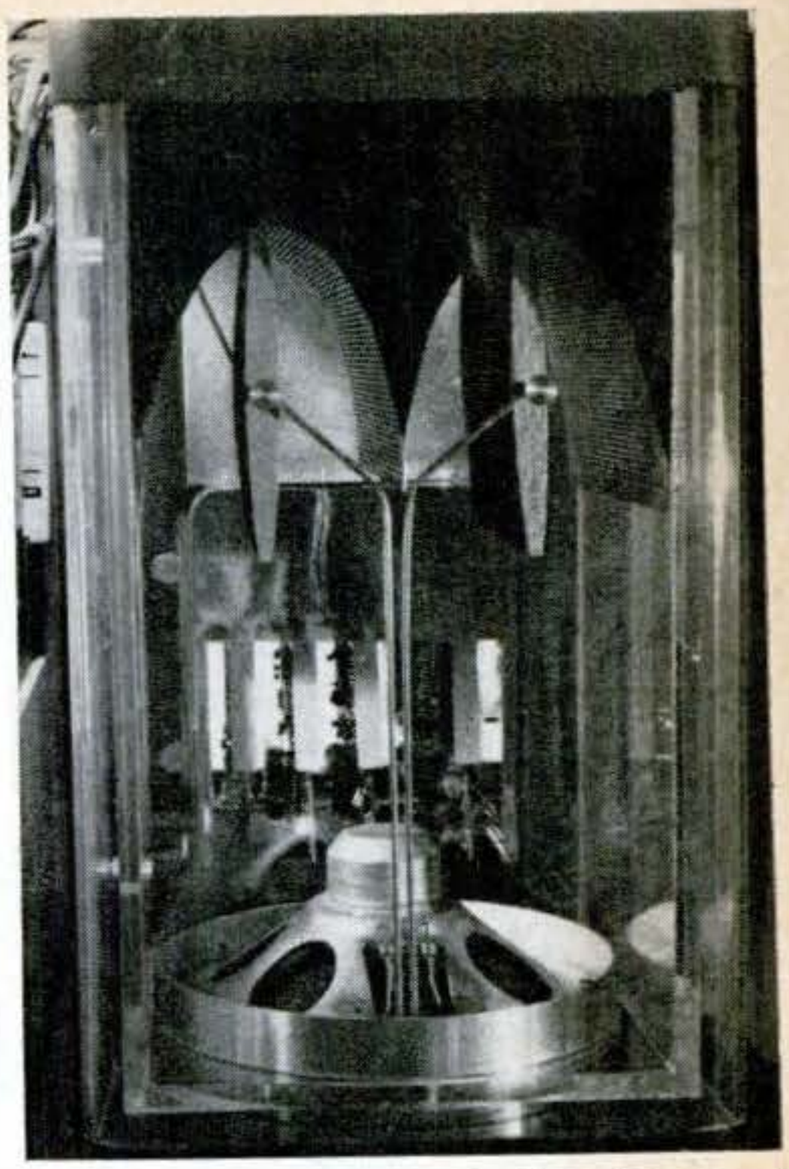
Where the Action Is

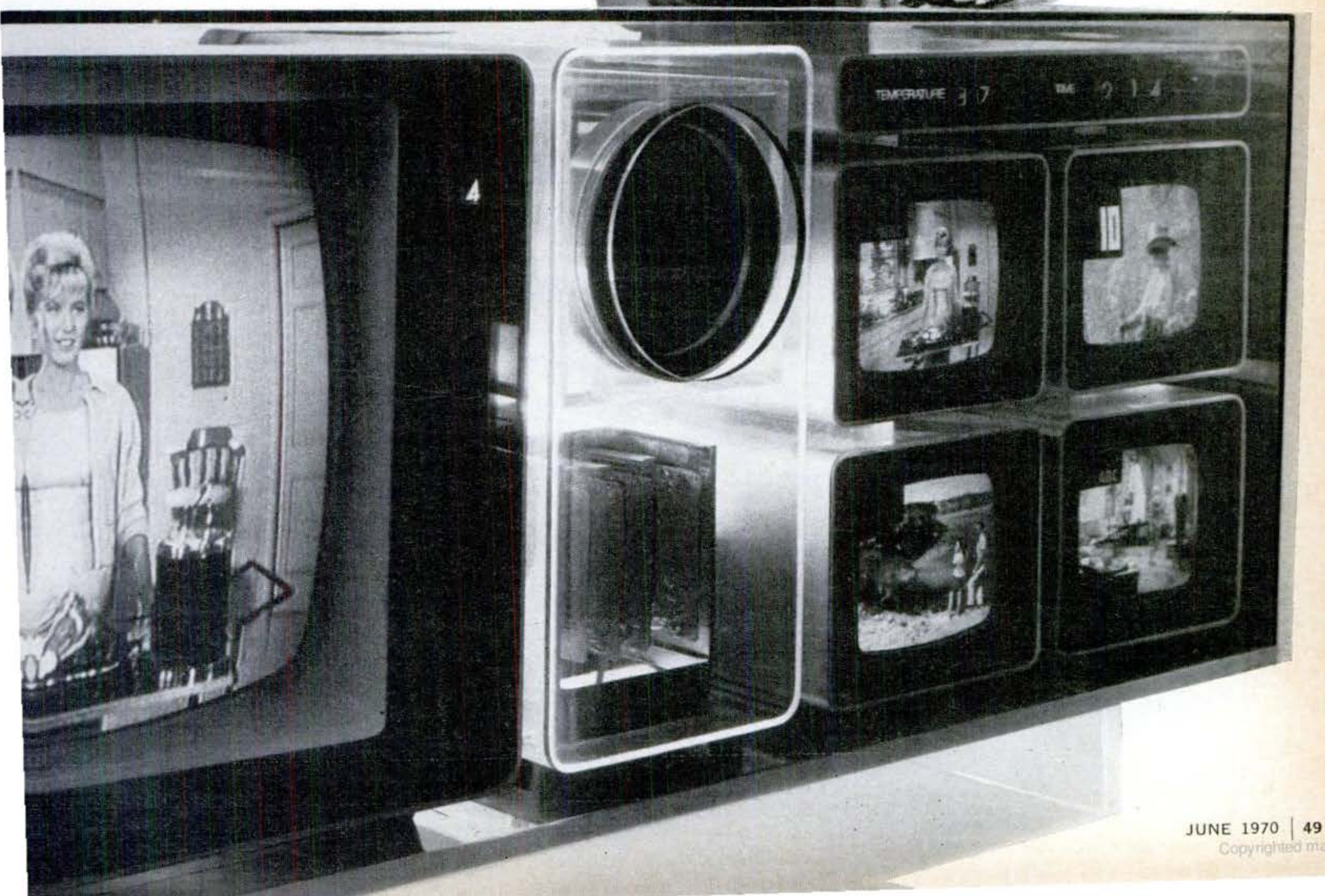


Solid-state logic circuits interpret signals from the remote control, switching the channel you choose for viewing from the monitor screens over to the big color tube.



Acoustical problems of see-through plastic speaker enclosure are solved by use of fiberglass insulation (black area at top of photo). Mesh parabolas conceal fiberglass and direct stray sound waves into sound-deadening baffles at their foci.

Wayne Evans, multiscreen project engineer, calls the set a "feasibility study."



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VEGA (XP-887) from Chevy will come in four body styles. Top, GT coupe with its fast roofline will probably be a '71½ model. Center, the base-model two-door sedan. Bottom, the wagon, will also be built as a panel truck.

MUSTANG has a new body, once again. It's longer and wider than ever, and shares its mechanical components with the Fairlane series. All three body styles (notchback coupe, fastback coupe, and convert-

THE '71 CARS:

Mini-compacts get the limelight, but there's important news in all size and price classes

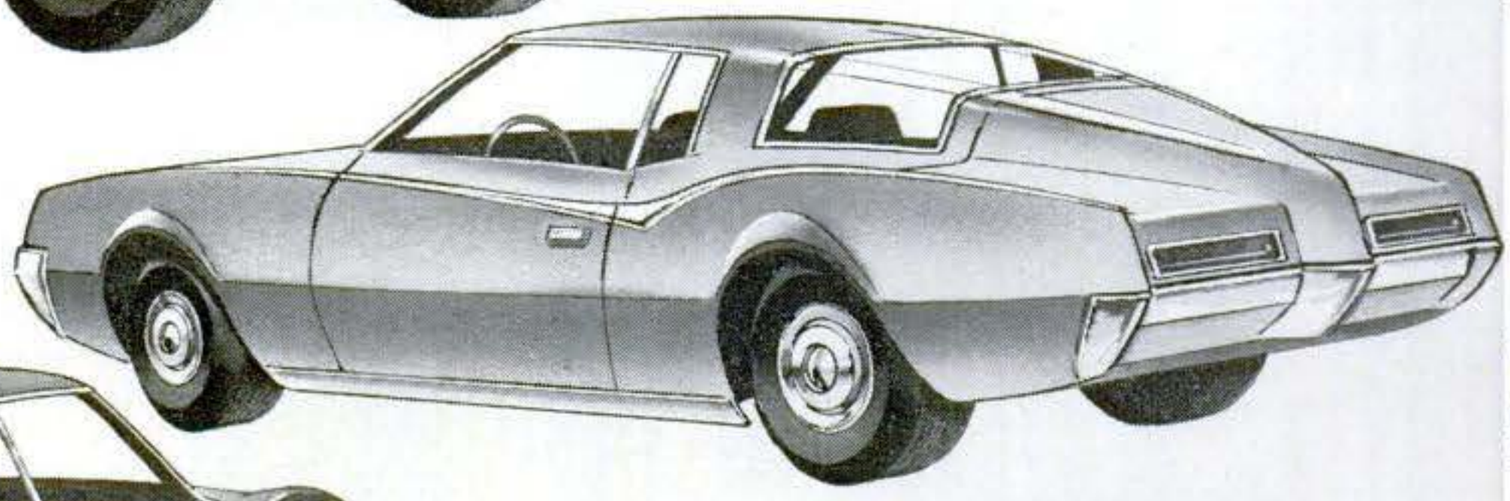
By **JIM DUNNE** / *PS Detroit Editor*

No matter how you cut it, 1971 will be the year of the small car. Sure, Detroit will bring out restyled Fords, Chevies, Satellites, and Javelins, but the small car will capture the most interest—and a big share of the sales—when the '71 models are unveiled next fall. With competition from foreign cars of prime interest, the whole world will be watching to see just what

You'll see some new cars with old names, plus

MONTEREY continues as the low-line full-size Mercury, with crisper, cleaner looks than this year's model.

BUICK RIVIERA has striking fastback roofline, reminiscent of 1949 Roadmaster coupe. Rear window curves around the sides.



JAVELIN by American Motors will have an all-new body in October, recognized by humps over the front wheels and a new rear end.

GALAXIE is Ford's flagship. New front end carries Lincoln influence.

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ible) are continued. The fastback is spectacular—looks like something straight off the speedway at Daytona. Mustang is still the best-selling sporty car, but sporty-car sales are down. New look might send sales up.

MERCURY COUGAR is again growing in size. New body has styling that stresses its kinship to the Montego, with Cougar's own distinctive front.

What Detroit Isn't Telling You Yet

the U.S. makers have going for them in the battle for domination of the small-car market.

Start with Chevy's small car (XP-887) and Ford's Pinto. Most of the details of these cars were revealed earlier [PS, Feb. '70], but last-minute changes have been made and are now firm.

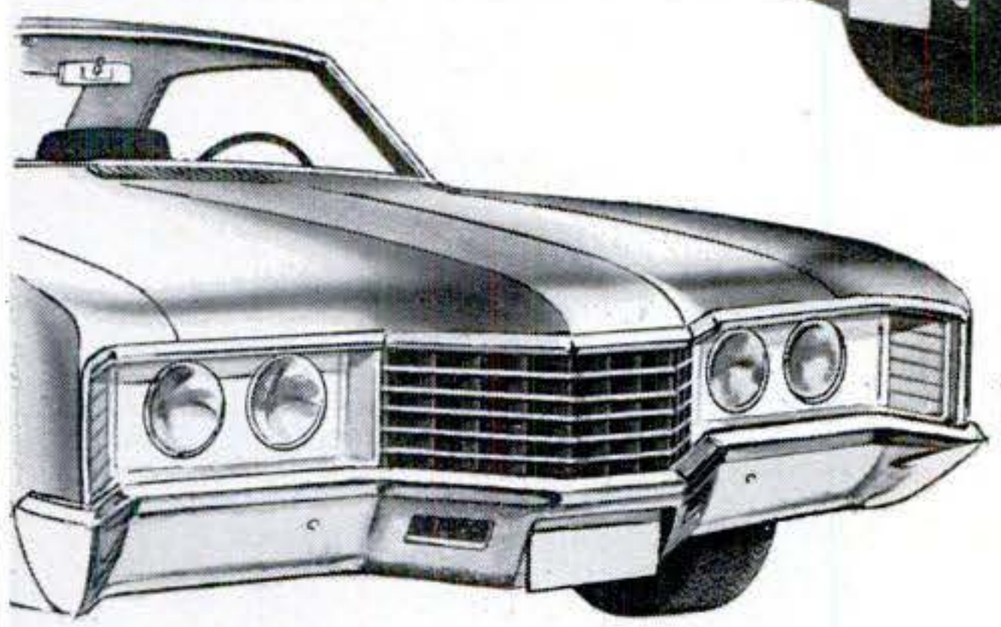
Chevy will introduce its small car in August, put it on sale about the 1st of September. Four body styles—base sedan, three-door coupe, station wagon, and a delivery van—will be built. Base price for the cheapest model is expected to be right around $1,925, but with an optional-equipment list that includes air conditioning, stereo radio, automatic transmission, power assists, and trim packages, the sale price of a

[Continued on page 110]

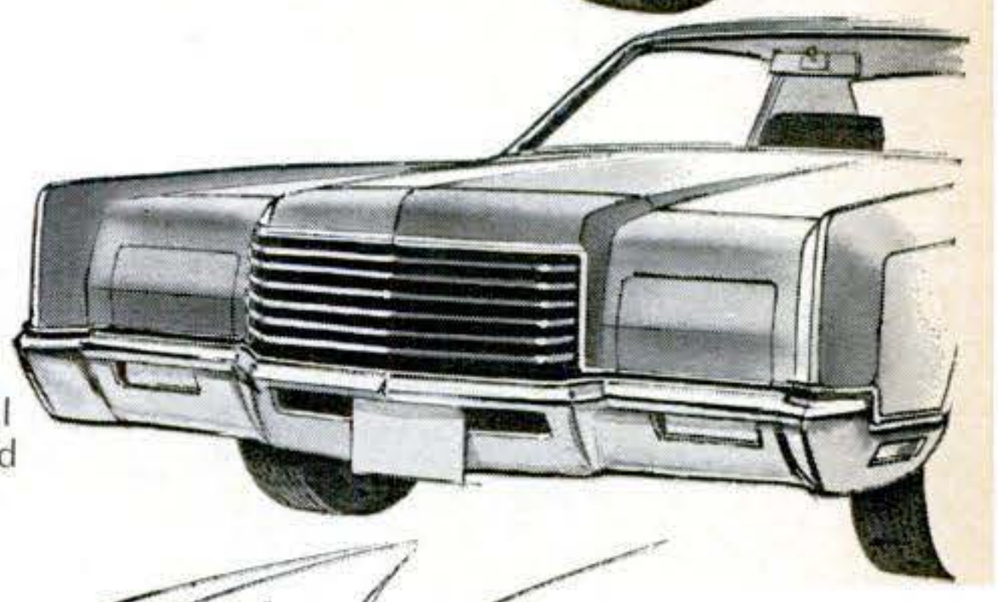
FORD PINTO is the mini-compact that will compete with the XP-887. There's only one body style: this two-door semi-fastback sedan. Smaller, lighter, less expensive than the Maverick, the Pinto should find ready demand.

several new models with new names

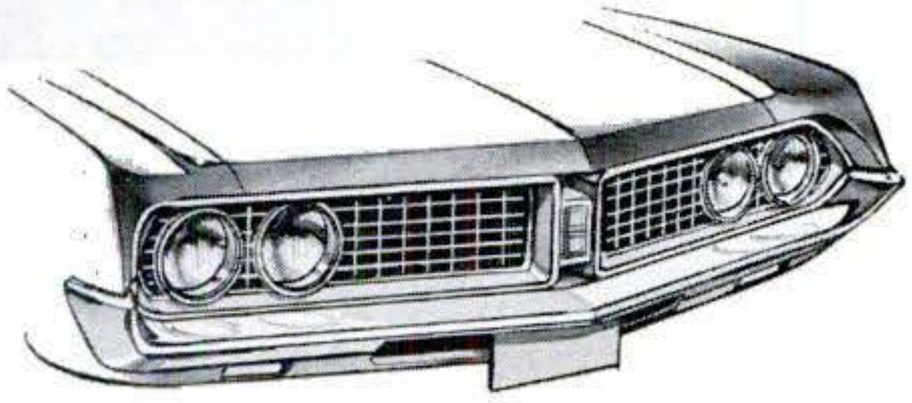
PLYMOUTH will introduce all-new bodies for its intermediates, led by the Sport Satellite two-door hardtop.



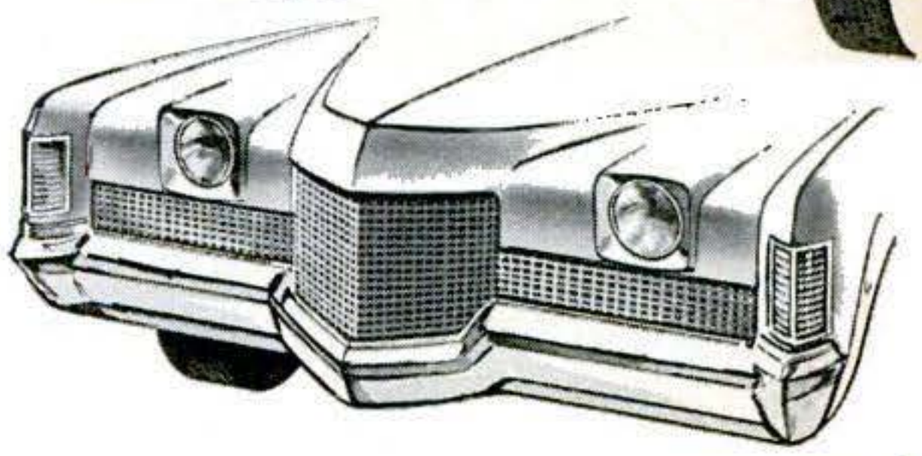
MONTEGO continues as Mercury's intermediate, with a more modest nose.



LINCOLN Continental will get a new grille and hideaway headlights.



TORINO, Ford's intermediate, will get a rather minor facelift for '71.



PONTIAC Grand Ville is new top-of-the-line model, replacing the Bonneville.

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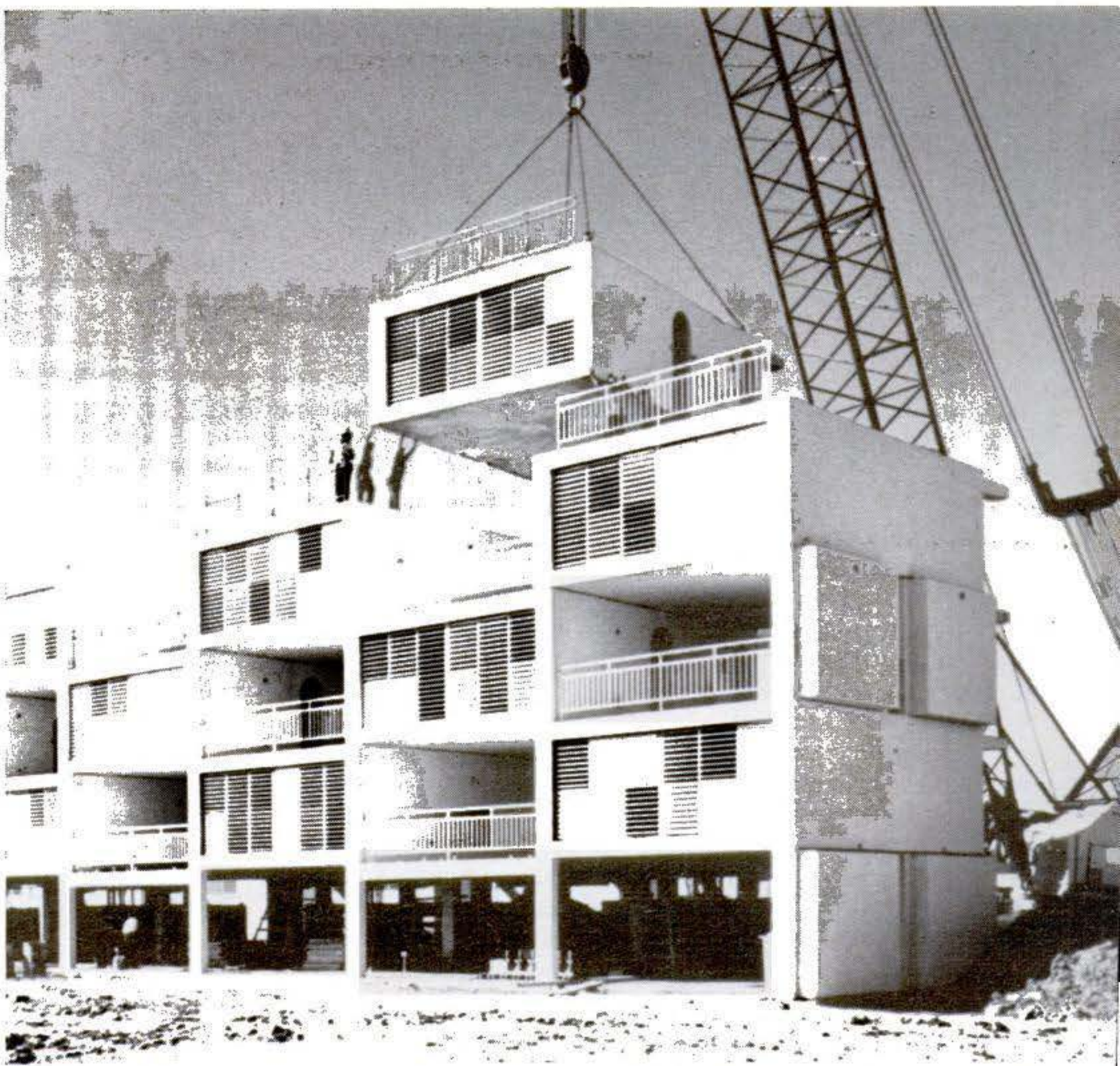
Mass-produced and delivered to your building site by trailer truck

FACTORY-BUILT HOUSES

Frustrated by the costs and delays of home buying? Operation Breakthrough may smash the building logjam

By JACKSON HAND



Modular designs of many firms picked by HUD suit individual homes, town houses, or low-rise multiples. These concrete modules are made by Shelley, in Puerto Rico.

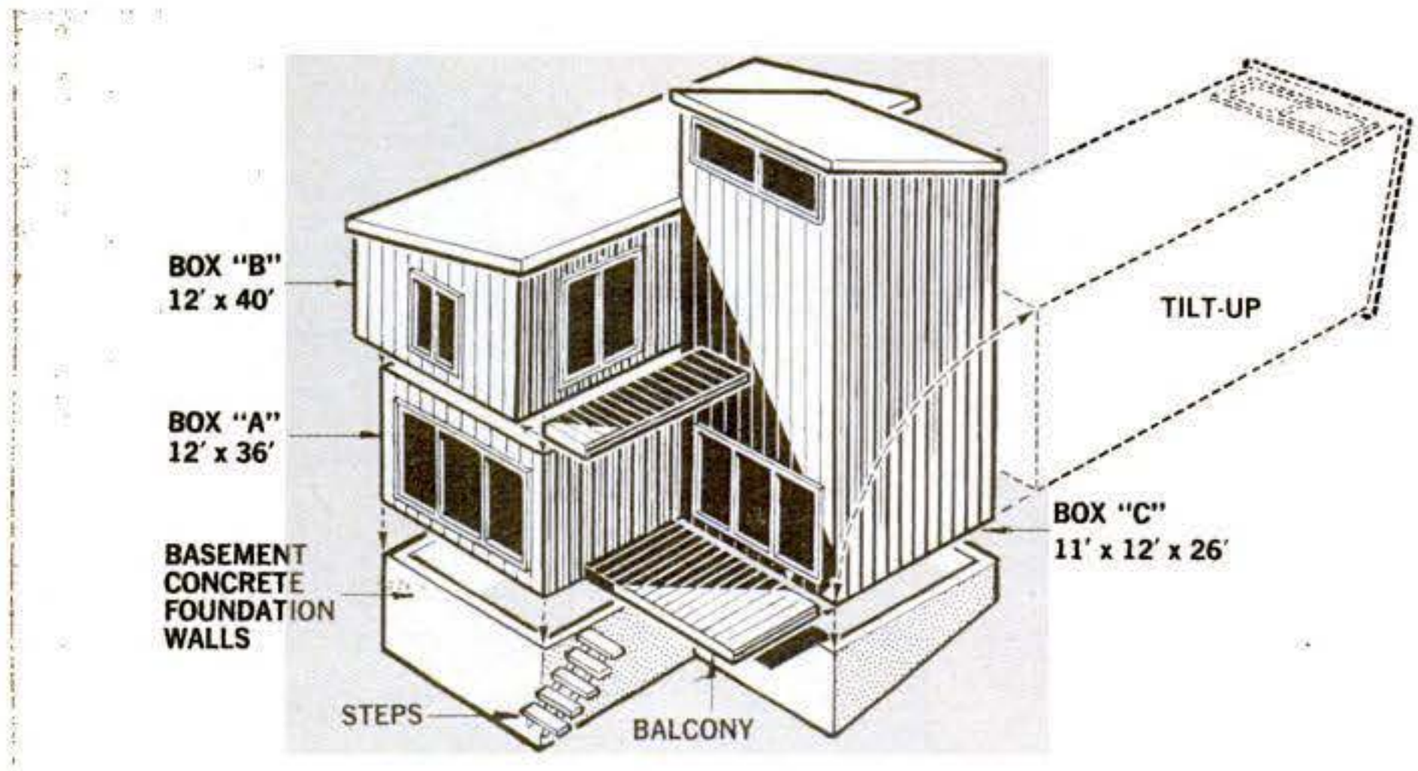
Last March, Housing and Urban Development Secretary George Romney announced the 22 winners of Operation Breakthrough, a government-sponsored competition to stimulate new techniques in the homebuilding industry. The companies chosen were given HUD contracts to build 2,000 houses and apartment buildings across the country. (Some of the winning designs are shown in some of the pictures on these pages.) The plans indicate, in the words of Secretary Romney, "what is possible under existing technology."

Why did the U.S. government engage in such a project, at a cost of some $50 million? Because our housing problem is desperate.

When the world moved into the age of mass production, we left housing far, far behind. Almost everything you buy today came off a precisely engineered production line. But not the house you live in. It is still put together board by board, brick by brick, in a process that is at the mercy of the weather and the archaic, painfully acquired skills of laborers taught how to work in stereotyped ways with stereotyped materials.

As a result, America—the land of plenty—is drastically short of housing. More units are demolished or become unlivable every year than are built. You can't find a house, and if you do, you can't afford it.

All this may come to an end if a new trend in modern building techniques lives up to its promise. This trend is *modular construction,* a system in which three-dimensional sections of a building are mass-produced in optimum working conditions, then brought together into a full-size home



Typical go-together methods for modern houses are illustrated in this drawing of a Hercules design. Modules are in three simple shapes. Two of them stack, then a third is tilted on end. The same units could be assembled in several different ways.

Although interior design can be entirely routine, much modular construction of excellent design "lets the construction show."

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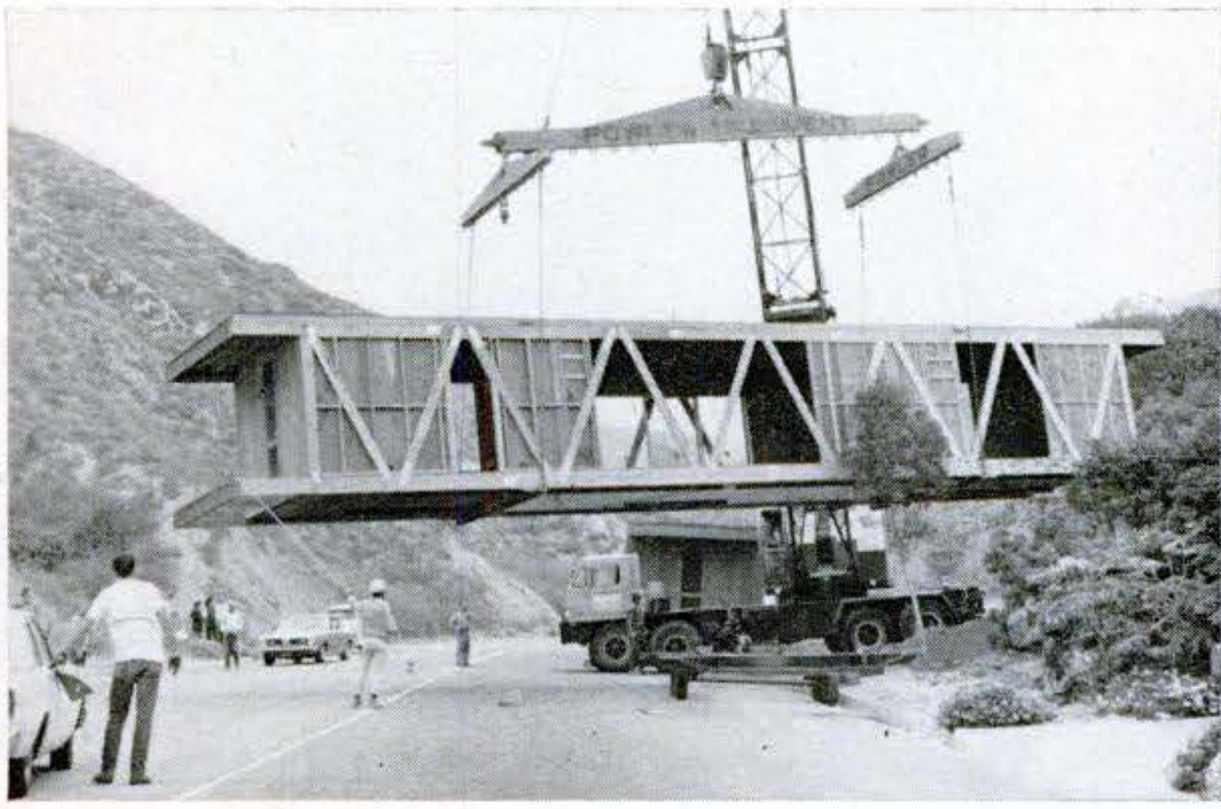
Will Cost Less, Give You More

Assembly-line production by Boise-Cascade turns piles of building materials into units complete with shingled roofs, carpeted floors, finished doors and windows. The whole unit is painted inside and out, ready to live in as soon as utilities are hooked up.

or even multiple-dwelling complexes.

Modular construction, an idea so promising that it has drawn scores of the nation's largest and most progressive companies into housing activities, has several tremendous advantages over house-by-house construction:

- **Speed.** You get the house much faster. Crews in "housing factories" can do in days what it takes months to do when houses go up on location. A typical producer can turn out five (count 'em) five houses a day. Figure a week for the foundation to be put in, a day or so for the modules to be put in place and the "seams" covered, and a few days more for any re-



Modules delivered by highway can't be over 12 feet in width, but lengths reach 50 feet and more. California Redwood Association uses diagonal braces to safeguard units being delivered.

On location, resting on prepared foundation, the house has slimmer, more streamlined silhouette than that of most built-in-place houses. Design is Redwood Association's "Concept House."

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quired "tailoring"—and you're in the house in two weeks from the day you say go. The basic reason for the quick build in the factory is not only mass production with assembly-line techniques. More important, a great many old time-consuming schedules are overturned completely. Many operations go on simultaneously in modular construction that would have to wait on each other in outdated, first-this-then-that systems.

• **Labor effectiveness.** Vast numbers of workmen not qualified for one reason or another to work on on-site buildings are well suited to production lines, where less skill and less versatility are needed. A growing number of workers getting on in years are still useful wage earners, although they'd be risking life and limb clambering around a house in construction.

• **Weather be damned.** It takes a week or more of consecutive good-weather days to get the on-site house "closed in," so that it provides a workable environment, rain or shine. It's not uncommon for house construction to be held up for weeks at a time because of a bad run of weather. If you live in the northern states, you've got to rule out wintertime as building time. This not only affects the start-to-finish span, but also puts labor into a five-month deep-freeze. In contrast to all this, a modular house can be closed in on any pleasant day—so tight that it ends the weather problem before it starts.

• **Materials.** You can wind up with a better house, since many of the limitations on materials disappear. Much of what goes into a standard house is—like the methods of putting it together—dictated by a long tradition of expediency. A building product has always had to be something one man, or one man and his helper, could hold up in position and nail in place. But not with prebuilt modules. A building material can now be judged on the basis of its performance, and cost efficiency alone, for a method of handling it in a factory situation can surely be found.

• **Cost.** All of this spells efficiency, and the prices go down, down, down. Estimates of cost reductions run as high as 20 percent, a figure cited by General Electric, one of the important new makers, for a four-bedroom house. Prices of $12,500 and less are quoted by some producers for three bedrooms, two baths, living room, dining room, and fully equipped kitchen—appliances and all. Another producer, whose aim is the $20,000 class, talks of saving you $3,000.

And there are hidden savings—as opposed to hidden costs—in many of the modulars. Many of them are prequipped with floor coverings, blinds, combination storm-screen doors and windows, and other staples—all included in the initial cost.

How good a house? You never get a worse house—most often a better house. Take the simple matter of lumber. In the typical modular the lumber is kiln dried—somewhat of a phenomenon these days, but fairly simple at a house factory, where huge quantities of materials are stockpiled. Construction usually involves the next-heavier grade of sheathing, sheet-form siding, and similar materials. Glued-up construction is common. In general, construction throughout is more rugged than it is in ordinary housebuilding, for two good reasons:

First, jigs, forms, mass-multiple-cutting operations, and the use of larger units are possible in the factory, where a wall may be assembled flat—the easiest way.

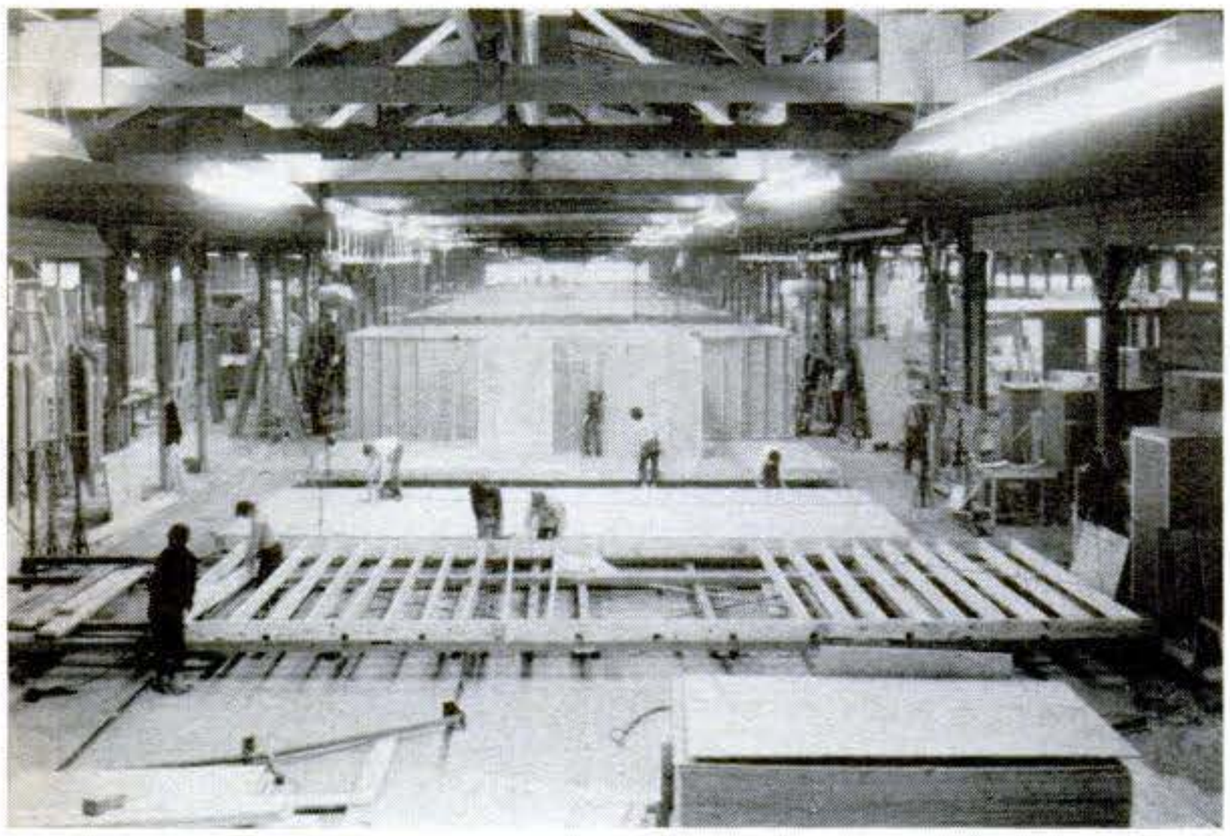
Second, a bit more rigidity and quality are necessary because of the cross-country ride the module will take; it will suffer some strains that an ordinary house would never experience. In other words, a built-in-place house merely has to stand there; a modular house not only has to stand there—it also has to be rugged enough to travel there in the first place.

Design factors. A modular can be indistinguishable from a regular house in its design. In fact, it is one of the boasts of the industry—"You can't tell our modular house from an ordinary house." This is, of course, sensible. Few people want to invest any money at all in a house that's so way-out they might never be able to sell it if they wanted to.

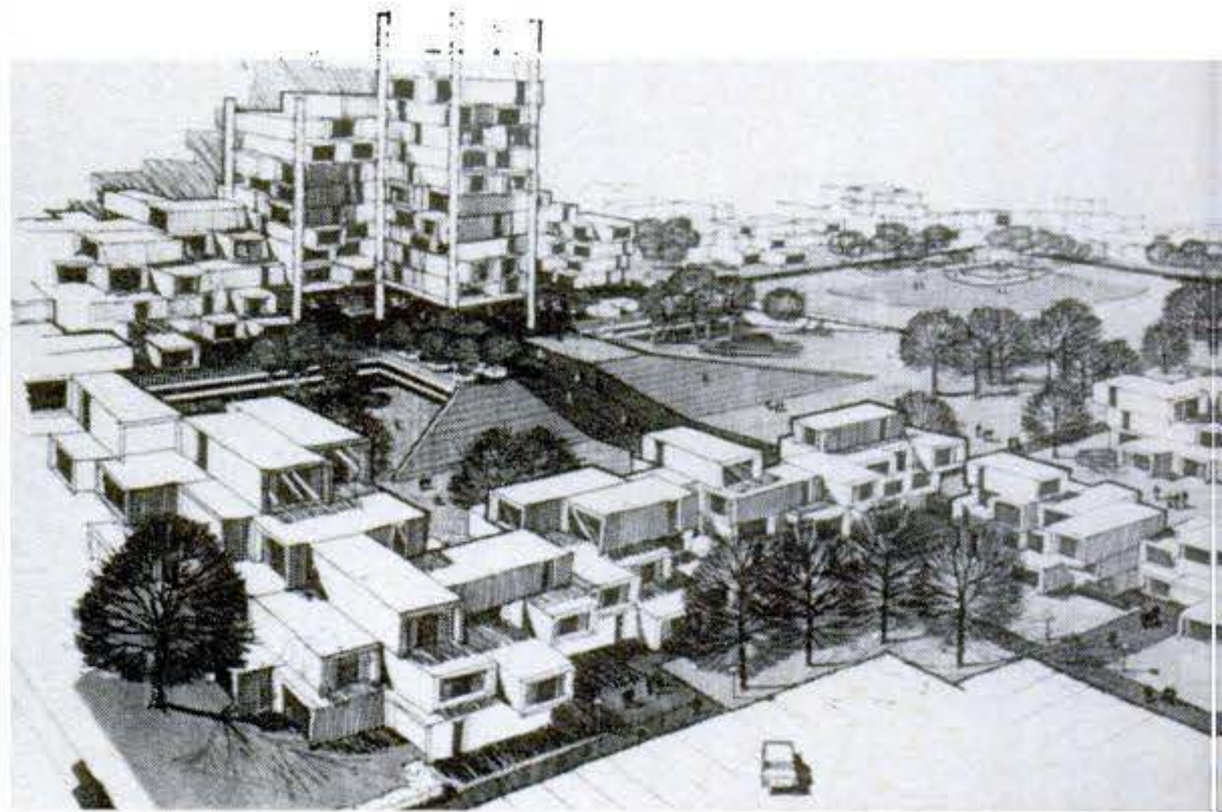
On the other hand, the modular concept itself can stimulate outstanding new designs, either because in-plant construction makes certain design-engineering features possible, or because the module frees the architect to think along new lines.

The shapes of modules (arched roofs, wedge shapes, polyhedrals) will play some role, but it's likely that originality and freshness in design will derive more from the way functional-to-build rectilinear modules can be put together in new ways.

Although the modular homes we have today are largely four-square, double-pitch-roof, meet-the-market dwellings, on the drawing boards (and in some actual buildings) it's a different story. First, you don't have to stack the units like four shoeboxes on a shelf. They can be staggered . . . criss-crossed . . . L-arranged . . . E-arranged . . . T-arranged . . . and—okay—K-arranged. One end of the modules can rest on a foundation, the other on columns. They can go shelf-like up a hillside, edge-over-edge or end-over-end. The roof of one module can be the deck serving the module adjacent to it. Four units can form a box around a central court, one of the best new ideas in modern designs.



Greatest money savers in modular construction are speed and efficiency. Gangs produce walls, floors, ceilings. Other gangs assemble them. And there are no costly "weather breaks."



Modules support each other in units up to three or four stories high. Above that level, structural "shelves" go up and modules slip into them, as in this National Homes community.

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Living it up. More sophisticated modular planning combines related units of several different shapes—some rectangular, some triangular, some quadrilateral. The units go together in numberless ways, ranging from a modern reminiscent of the traditional saltbox to a modern that is strictly its own thing. One proposal is for a group of octagonals, each with its own function (living room, sleeping room, kitchen utility, bath, and so on) all joinable to one another. You can put together a snug grouping, or you can wander, with units touching each other only at one side.

There's a limit. Whatever its shape, the overall dimensions of the basic module are restricted by some elementary considerations. It is made in a factory up to 300 miles from the building site and must be trucked or helicoptered or otherwise transported there. Most highways are limited to a 12-foot load width. That immediately established one dimension of the module. "Danger: Low Underpass" establishes another. Lengths may be 50-60 feet or more.

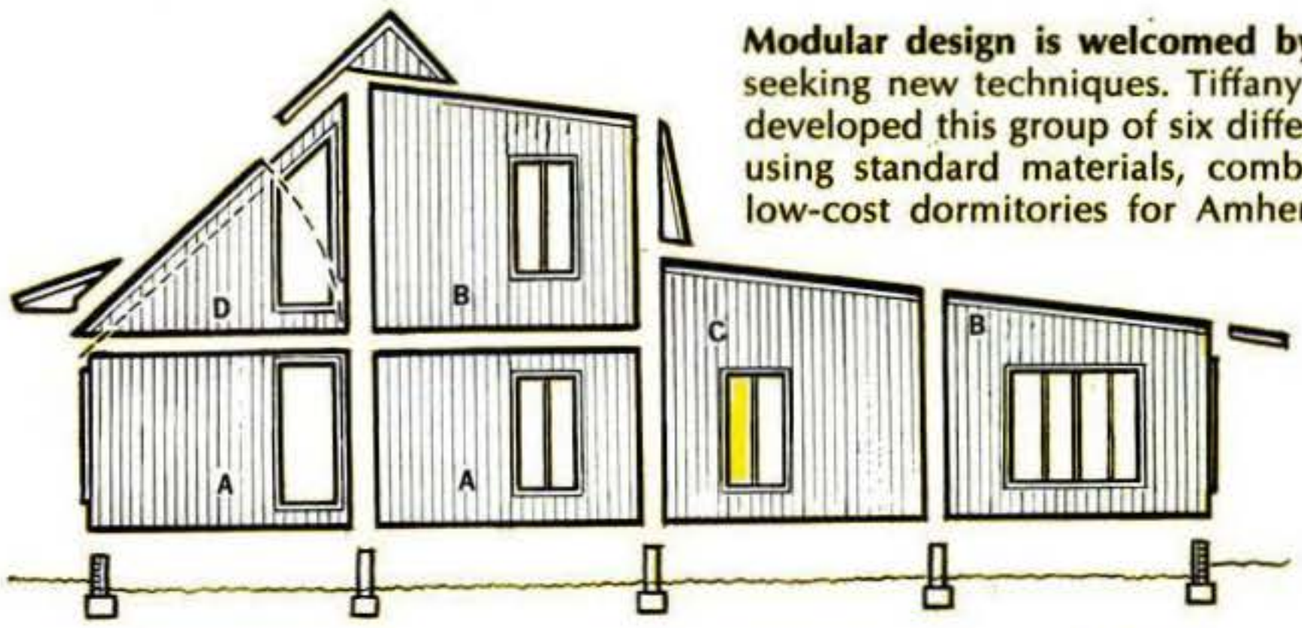
Such a module is heavy. Keeping it as light as possible is a job for the engineers. (As a matter of perspective, famed Habitat, of Montreal's Expo 67, had modules weighing 90 tons, much too big for highway transport, manufactured on the site in a special factory, and erected by means of a special $750,000 crane. Habitat was an experimental prototype and cost a wild $89.42 per square foot because of heavy start-up expense.)

What materials? Seeking for materials good enough for construction uses, yet light enough to be transported in three-dimensional modules, the industry has been limited pretty much to things we already know about!

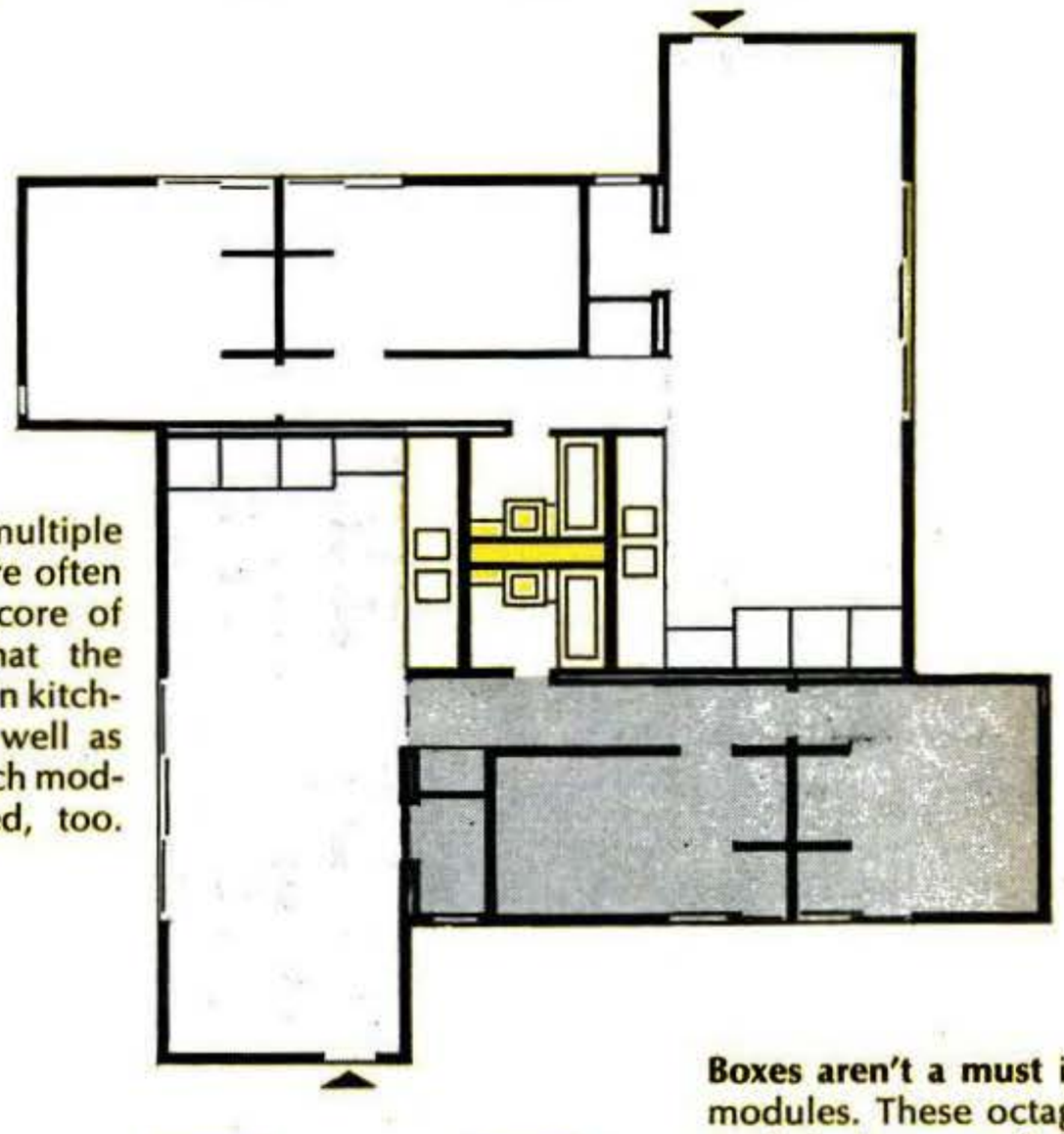
- Plastics: Most attempts to mold plastics into modules come out looking like poor igloos. As a foam, however, sandwiched between facings of metal or plywood, plastic makes a useful contribution. It is light, functions well structurally by providing thickness to the sandwich, is excellent insulation, doesn't cost too much, and is quick to handle. Plastics are also used within modules for such refinements as the all-in-one-piece bathtub and shower enclosure developed by Owens Corning. Dow Chemical has found that a form of "spun" plastics works well in hex-form modules.
- Metal: Steel and aluminum are widely used, since their strength-to-mass ratio is good. Walls, both inside and out, are prefinished aluminum or galvanized sheet in some modulars. Sometimes steel tubing forms the framing, combined with plastics or wood and insulation.
- Concrete: Concrete, precast with light-weight aggregate, shows up most often in multiple-dwelling modulars, where its fireproofness is an advantage. Here, the technique is more ground-level production of units for

[Continued on page 119]

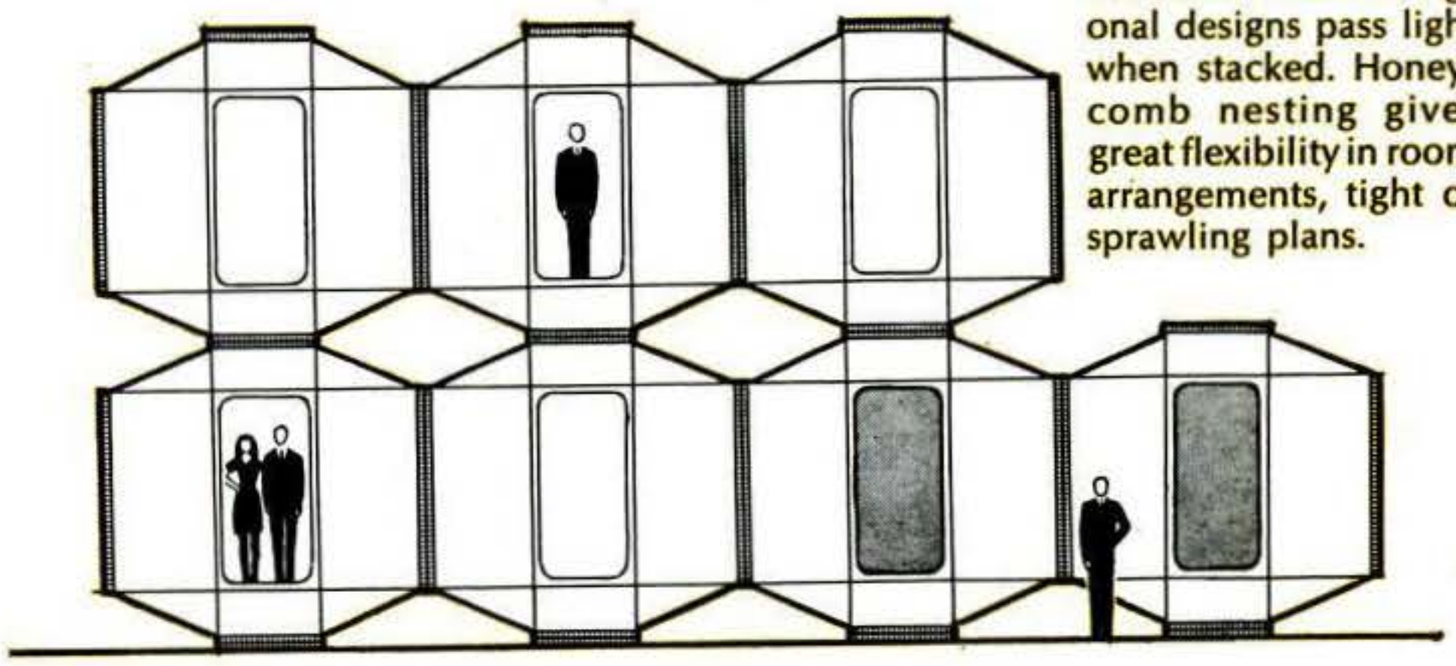
SHAPE THEM, STACK THEM, STRING THEM OUT



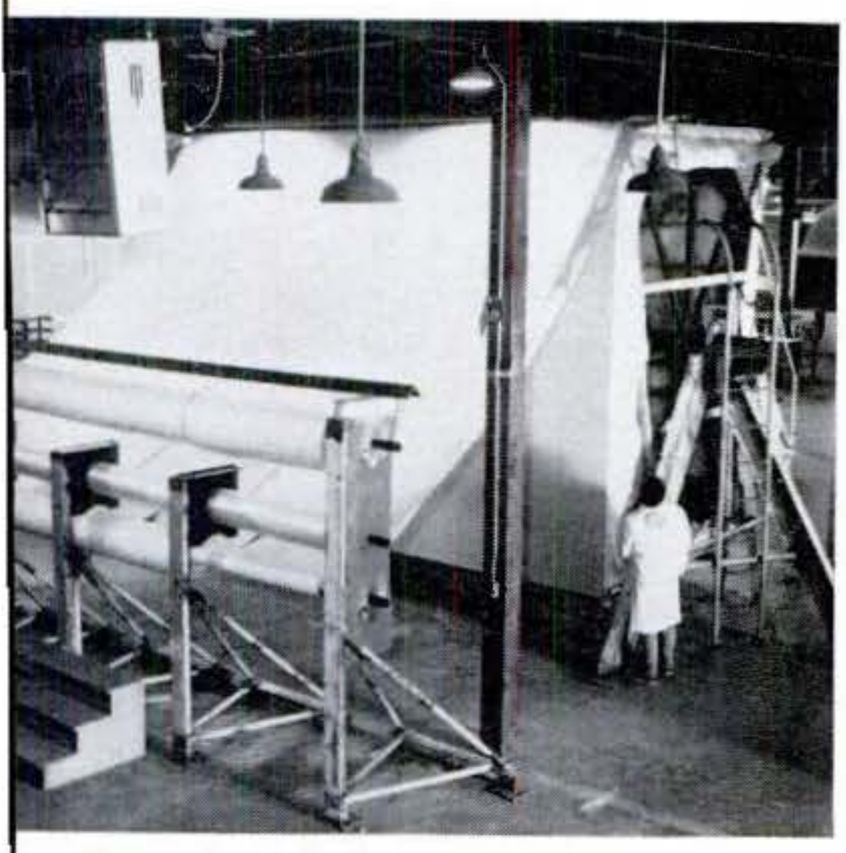
Modular design is welcomed by architects seeking new techniques. Tiffany Armstrong developed this group of six different shapes using standard materials, combinable into low-cost dormitories for Amherst College.



For efficiency of multiple housing, modules are often grouped around a core of utility units, so that the modular idea works in kitchens, baths, etc., as well as in regular rooms. Such modules can be stacked, too.



Boxes aren't a must in modules. These octagonal designs pass light when stacked. Honeycomb nesting gives great flexibility in room arrangements, tight or sprawling plans.



Unusual method of making modules—from TRW Systems—wraps gigantic rolls of fiberglass and plastic around a special core.

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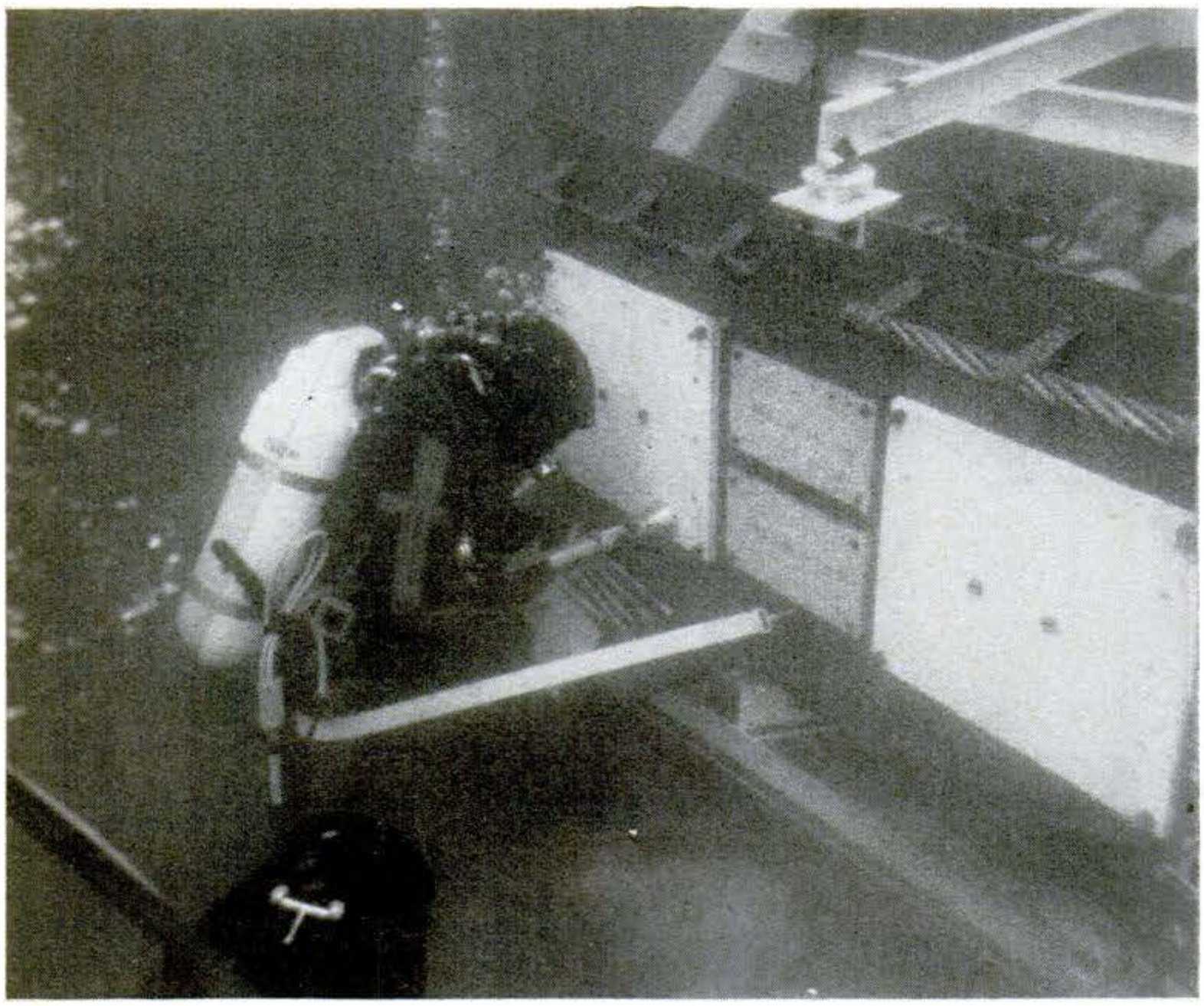
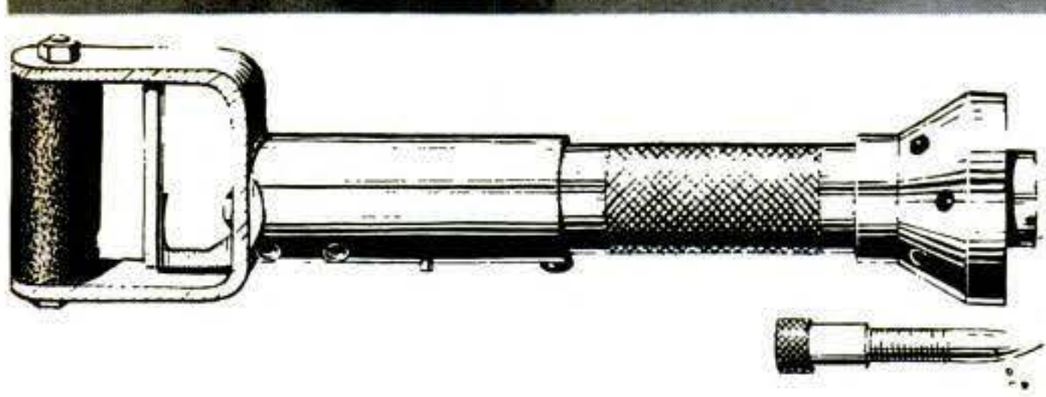
Ingenious Tools Work for You





Tethered like an astronaut, Navy diver tries out an explosive-powered stud gun, pictured at left with one of the steel spikes it drives through thick plate to attach a lifting pad to the hull of a sunken vessel.

Divers perform tasks of salvage, construction, repair with these novel undersea aids—and, like astronauts, have their problems in staying put at their jobs

When a diver tackles the job of raising a sunken vessel, constructing an undersea base, or repairing a submarine oil pipeline, he needs unconventional tools specially designed to work beneath the sea. Meeting his requirements has brought forth a whole bagful of ingenious devices, some quite recently perfected, for drilling, hammering, cutting, and other tasks.

Like an astronaut floating in space, a tool-using diver faces weird problems. Unless he is securely anchored, trying to turn a nut with a conventional wrench is apt to spin him in the opposite direction. Pushing against his work propels an untethered diver away from it.

One answer is to harness himself in place as an astronaut does, with a restraining strap around his body. Alternative schemes provide a diver with a jacket, vest, or belt that uses hooks, suction cups, or magnets to keep him put as he works.

New power tools. Better solutions than body restraint have recently become available. An outstanding electric rotating tool that transmits little or no torque to the diver has been designed at Battelle Memorial Institute, and a similar tool called SeaPower has resulted from parallel research by a Cincinnati firm [PS, Sept. '69]. Through a hammer-and-anvil impactor, such a rotating tool applies energy in brief pulses. Interchangeable accessories adapt it for many uses—for example, a drill, a hole saw, or an impact wrench turning nuts up to 1½-inch size.

Although simple hand tools like an ordinary screwdriver, wrench, or hammer and chisel have their place in the sea, a diver's most effective work tools are *power* tools—pneumatic, hydraulic, electric, or those powered by the energy of explosive cartridges.

An explosive-powered stud gun. Using ammunition-type cartridges, a hand-held stud gun makes short work of attaching a lifting pad to a sunken vessel. It propels bullet-shaped steel studs with such force that they penetrate steel plates more than an inch thick, and resist a pull-out force exceeding 25,000 pounds; eight studs fasten a new-type Navy lift pad. Sealab II trials of an improved stud gun showed that it solved the problem of safely shielding a diver from the concussion.

The gun will also implant hollow studs, through which air can be pumped into compartments to make a sunken ship buoyant. An explosive-powered cable cutter has been devised to sever wires entangling a ship's propeller or a sunken hull.

Both hydraulic and pneumatic power are used to drive underwater tools—such as a speed wrench, a hand drill, or a small chipping hammer. In hydraulic tools, the fluid is usually a special oil that is returned to the pump after doing its work, and used over again. Seawater itself drives some hydraulic tools. These can be simpler because there is no need to return the fluid to pumps; it is exhausted into the sea. So is the air that drives pneumatic tools.

A salt-water pump can be near the work site, but a pneumatic pump must be at the surface to get its air. Work at great depths with pneumatic tools is handicapped by the long, stiff, pressurized hoses needed.

Hydraulic tools using seawater would be ideal, but for problems of maintenance and reliability; salt water is one of the most corrosive substances on earth. However, new metals impervious to salt-water corrosion are just around the corner.

Electric tools are potentially the best suited for use in the sea—say, to tighten nuts, bore a hole in metal to attach a flange or bolt, or drill coral to implant an explosive for blasting. Their development has been excruciatingly slow because of divers' deep-rooted fear of electricity in the water.

Multi-purpose SeaPower electric tool with interchangeable attachments, shown fitted as hole saw, avoids spinning the user.

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Beneath the Sea

By CMDR. SCOTT CARPENTER, USN (RET.)

But protective devices that guarantee a diver's safety have now been developed, and I predict that electric tools will come into predominant use by divers in the near future.

Undersea cutting and welding. Cutting and welding tools are among the most important in a diver's tool chest. They come into play, for example, when a collapsed oil rig has to be cut up under water before lifting, or a subsea pipeline needs to have a defective section cut out and a new one welded in place.

An underwater flame-cutting torch burns an oxygen-hydrogen mixture, rather than the oxygen and acetylene used on land, because acetylene becomes unstable and dangerously explosive at a pressure equivalent to about a 30-foot depth in water.

"Arc-oxygen" cutting offers a faster rival method. An electric arc from a tubular electrode preheats the metal to be cut. Then a jet of oxygen, directed through the tube, burns away the hot metal.

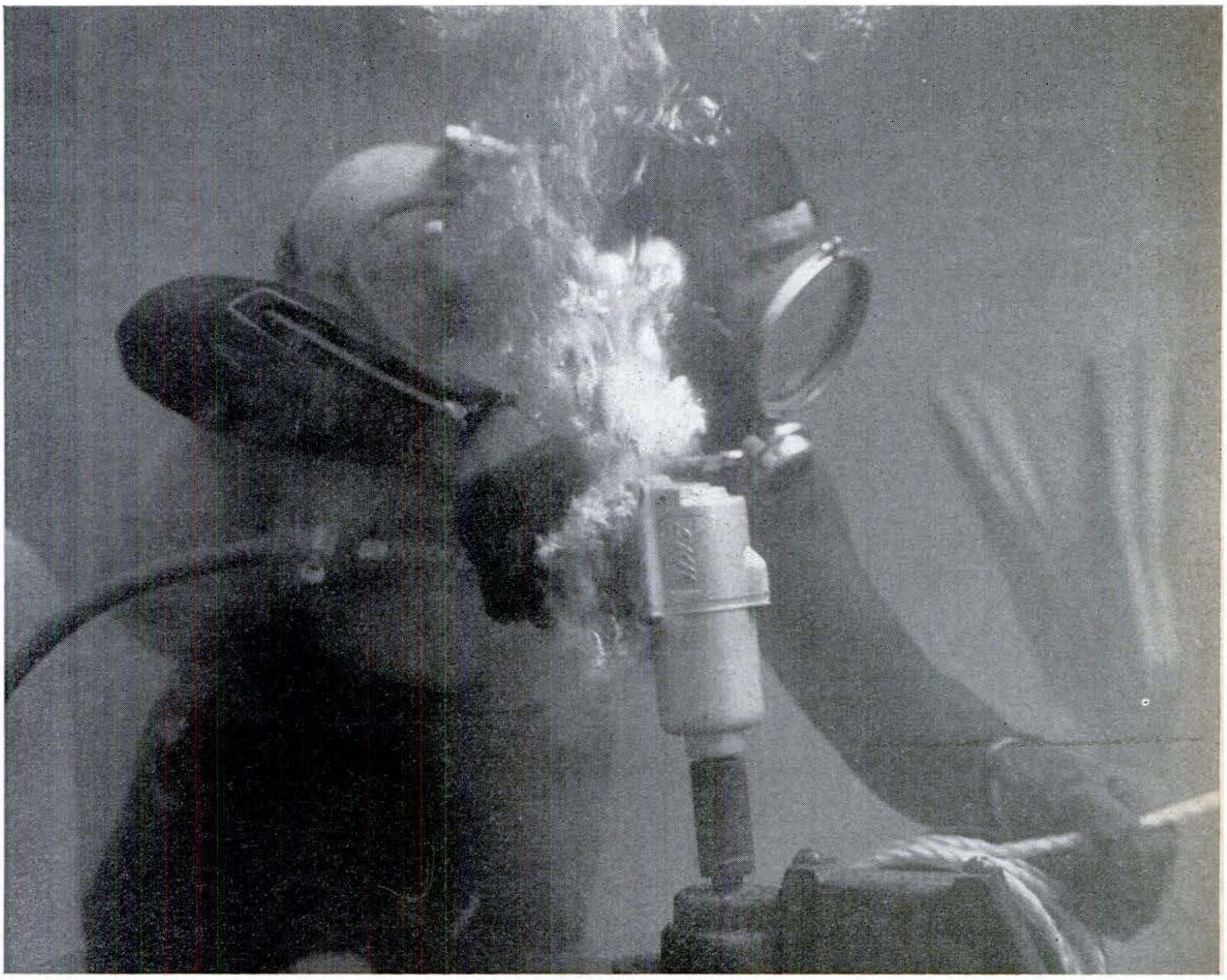
For underwater welding, a diver uses specially insulated electrode holders and waterproof rods. Even with the best of aids, however, wet welding is so difficult and time-consuming that it is being supplanted by a larger-scale "tool"—an undersea chamber enclosing the work to permit dry welding.

Many advances over present-day equipment are feasible and foreseeable. Among them:

- "Weightless" underwater tools, less tiring to use, can be designed by adding chambers to give them neutral buoyancy.
- A Navy-designed overhead "chandelier" of floodlights on an octagonal frame illustrates new efforts to overcome poor visibility—a diver's handicap in murky depths.

World-renowned astronaut and aquanaut, who contributes articles regularly as PS Consulting Editor, Oceans.

We are only beginning to learn how to make our underwater work easier. In 10 years, a diver's tool chest will contain devices we haven't even thought of yet.



Pneumatic wrench speeds diver's task of tightening a nut. Air that drives it is exhausted into sea, so it needs no return line.

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New Overrunning Clutch Has No Moving Parts

THIS is probably the simplest clutch ever invented. Nylon fibers on one face bear against the metal screen on the other. The nylon fibers provide one-way, or overrunning, characteristics.

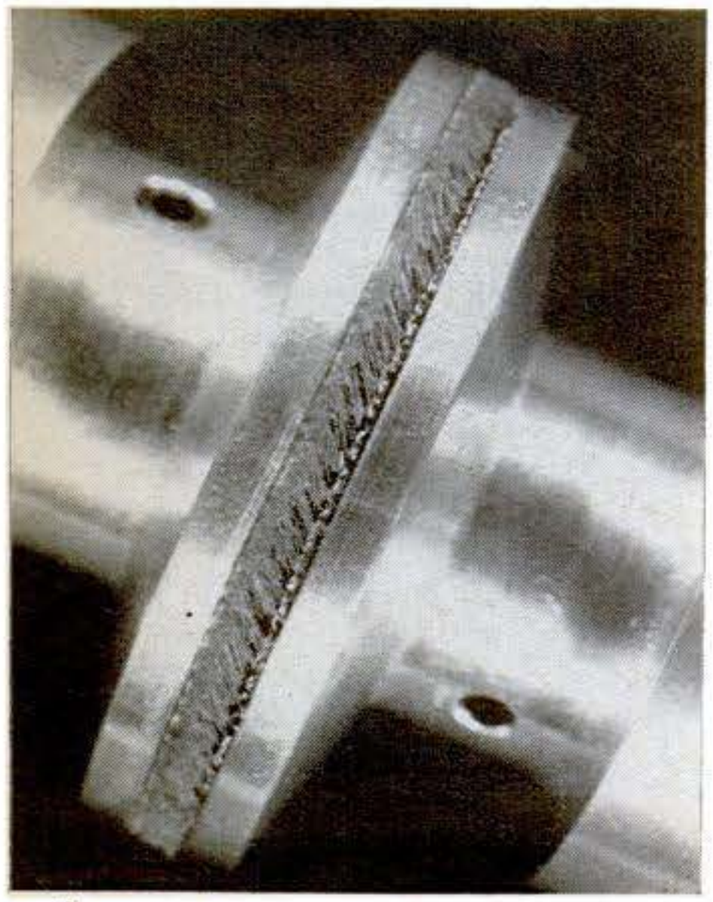
Just how do they do this? They are angle-mounted (see photo below), and catch on the screen in one direction, but slip in the other direction.

The 3M Company's Fibre-Tran clutch is intended for a variety of indexing, free-wheeling, and anti-backup applications, such as timers, counters, toys, office machines, etc.

Each face has a solvent-activated adhesive backing that will adhere to most surfaces. The materials continue to perform normally even when contaminated by oil, dust, water, and ice. Alignment is not a critical factor, either. The clutch can be overpowered without being destroyed, yet it assures a high drive-to-slip torque ratio.

The 3M Company claims a wide range of torque capabilities, and long life. In test, more than 200 million indexing operations have been run in one application, practically without deterioration.

Torque-load capacity for the largest size available (six-inch diameter) is 600 inch-pounds. The smallest unit has ½-inch-diameter faces and a torque limit of .16 inch-pounds.



By ERIK H. ARCTANDER

Propane fuels everything in this family's open tent camper. Bulk tank feeds a two-burner stove and a catalytic heater through hoses connected by cross manifold. The double-mantle lantern, mounted on a 14-ounce cylinder with slip-on stand, throws equivalent of a 200-watt bulb. The little cylinder will last five to seven hours. Appliances and fittings shown here are from Bernzomatic.

New portable appliances—fueled by bottled gas—illuminate, cook, heat, refrigerate, even kill bugs

Propane Power—Now

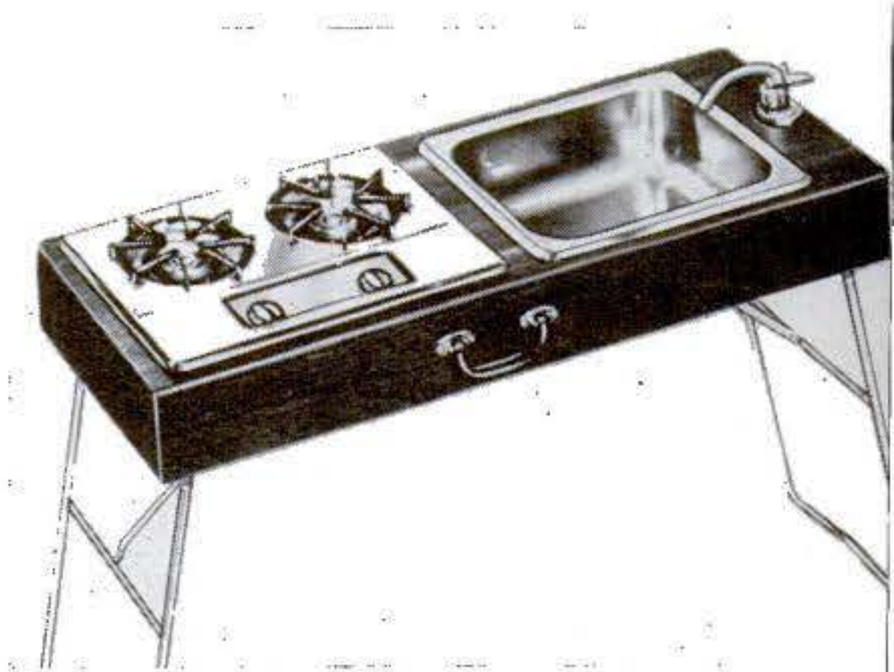
More campers will be fueling their portable appliances with propane than with gasoline in a few years, predicts Arne Ericson, president of Primus-Sievert. Ericson estimates propane usage now at 35 percent, gasoline at 65 percent.

Why the rapid switch to LPG (liquefied petroleum gas)? Here are the answers campers gave in a recent market survey:

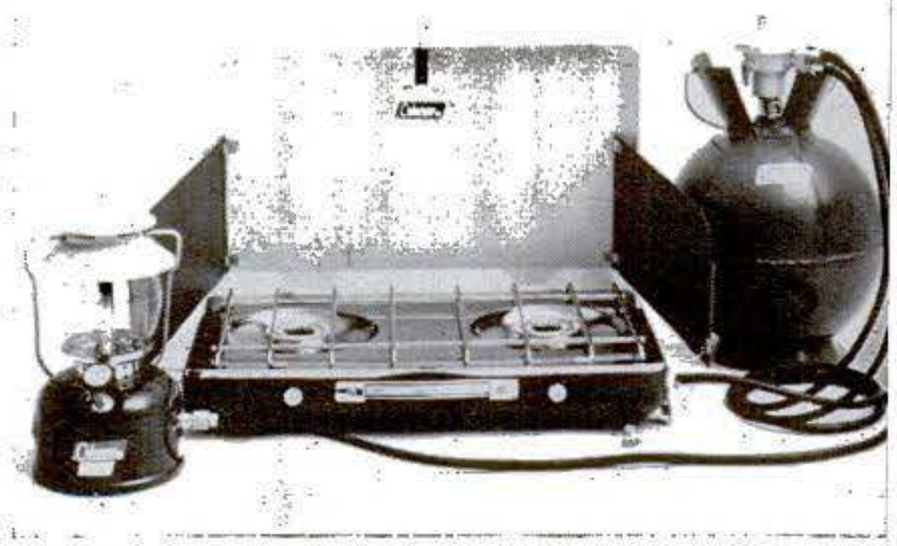
- Safer. No hazardous liquid to pour; no flareup when lighting.
- More convenient. No periodic pumping to maintain air pressure; one long-lasting fuel source can supply several appliances through flexible hoses.
- More familiar. Campers have been using gas appliances at home for years; many have also seen them installed in recreational vehicles.

Significantly, the Coleman company—whose gasoline lantern and stove have long led the field—brought out propane equivalents in 1968. Several other companies even sell a slip-in conversion unit so you can operate a Coleman or other gasoline stove on propane. Coleman itself makes no such conversion unit, says burners designed for gasoline are inefficient with gas.

[*Continued on page 121*]



Suitcase kitchen combines porcelain-enamel stove, steel sink in 40-by-15-in. base. Unit stands 29-in. high, folds to seven inches thick. $120 (Montgomery Ward).



Portable systems, like this Coleman ($72), are multiplying. For picnics, disconnect hoses, take just the stove with six-ounce can of Coleman's LP gas (60 cents).

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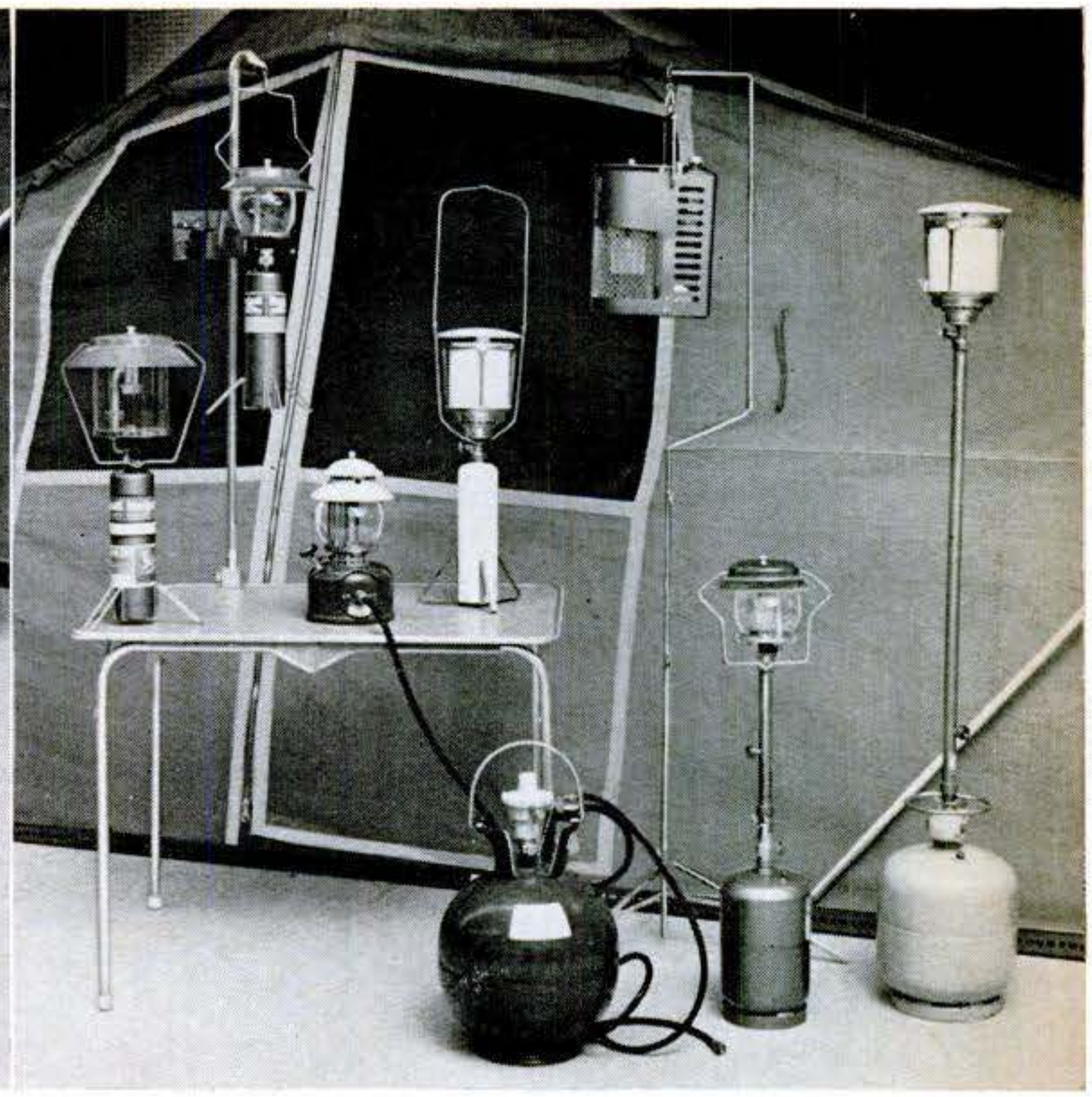
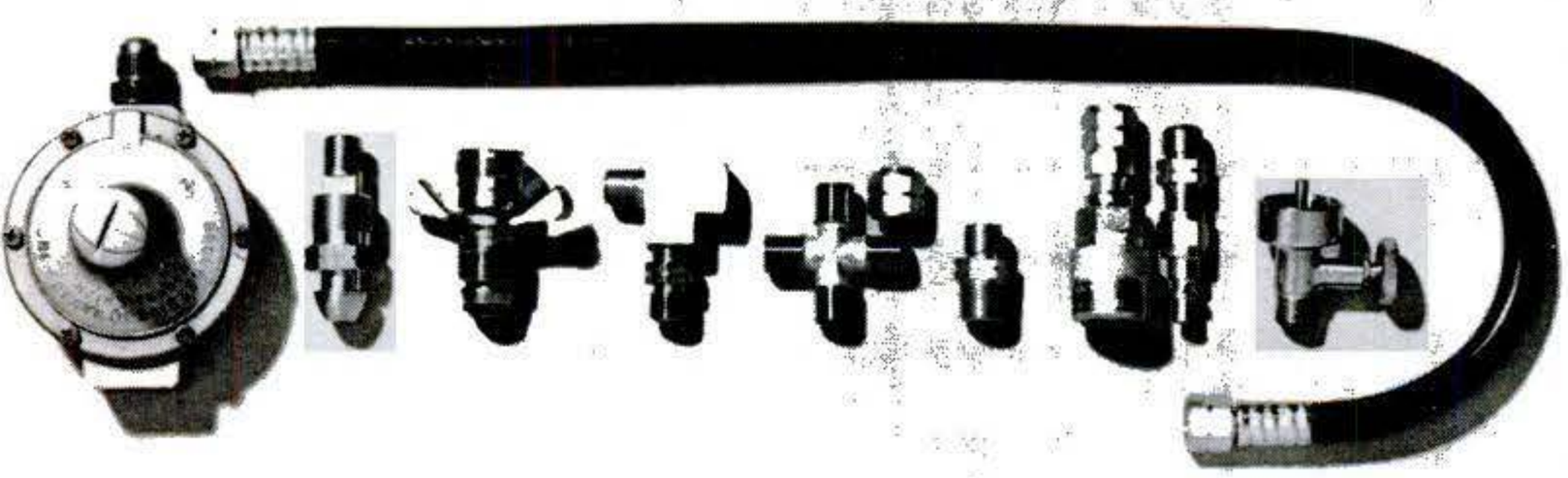
Sampling of stoves includes $20 and $40 units; average is $25 to $30. Economy models use screw-on cylinders; deluxe ones have hose-connected portable tanks. Brands shown here at Morsan store, Farmingdale, N.Y.: Bernzomatic, Coleman, Paulin, Primus.



Lantern lineup ranges from $12 to $22; average price is $14. Most have clear globes; some use frosted ones to soften the light. Accessories—such as table-clamped hanger, folding stand, Primus "safety post"—put lanterns where you want them.

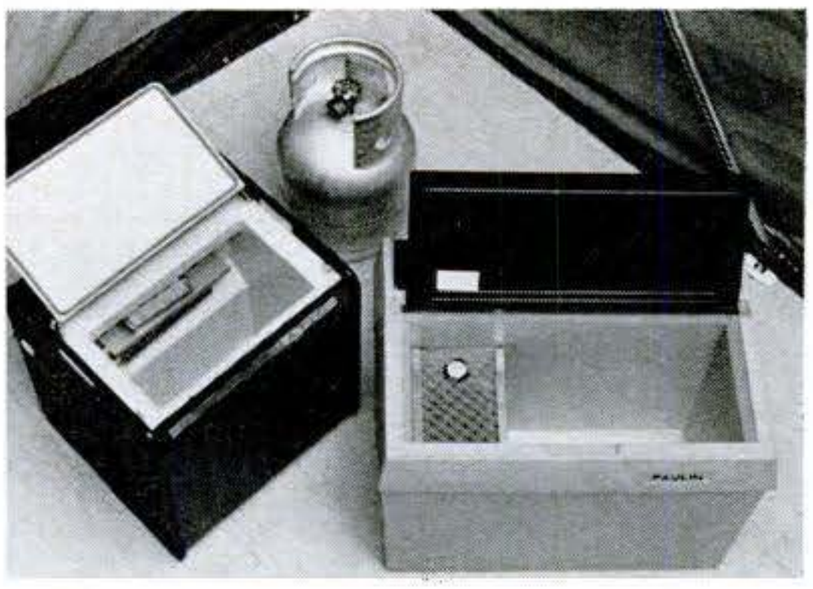
It's for Every Kind of Camping



Fittings let you switch from cylinder to tank, hook several devices to one source, fuel both high- and low-pressure devices. From left: pressure regulator, tank-to-hose connector, tank-to-device adapter, high/low pressure tee connector, cross manifold and cap, reducing adapter, quick-connector set, device-to-cylinder adapter, and hose.

One propane cylinder powers Bernzomatic's Jet Fogger ($40) for eight hours. Fogger shoots out mist of pyrethrin insecticide that's safe for people, fatal to bugs.

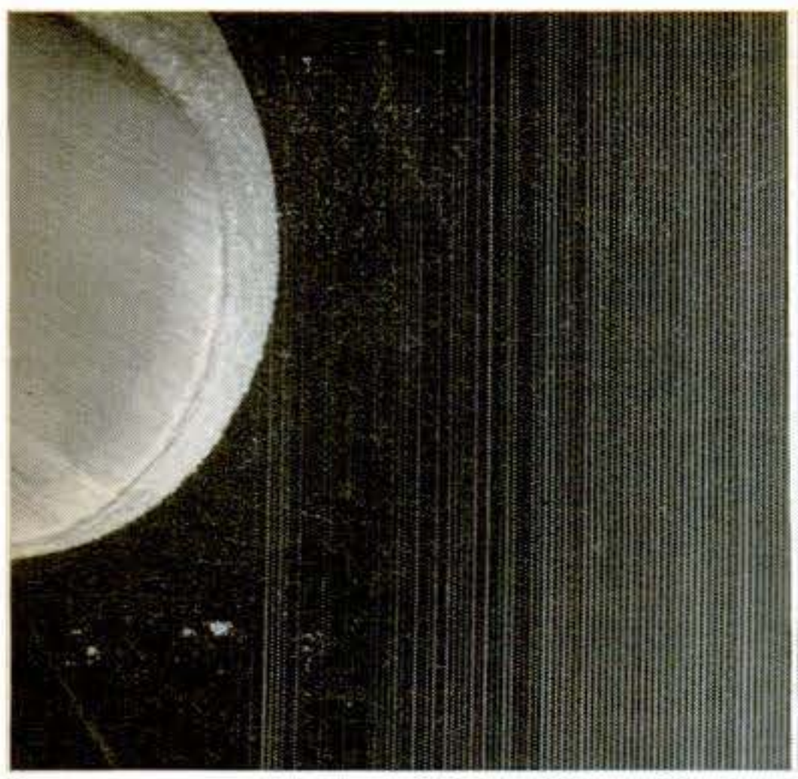
Propane heaters are catalytic or infrared. Catalytic at left puts out 7,000 Btu, costs about $45. Infrareds (right) give 5,000 Btu, double as stoves, and cost under $30.



Two refrigerators run on propane: Bernzomatic (left) holds 30 pounds, costs $140 with cylinder kit. Paulin holds 40 pounds; tank version is $160, cylinder kit adds $15.

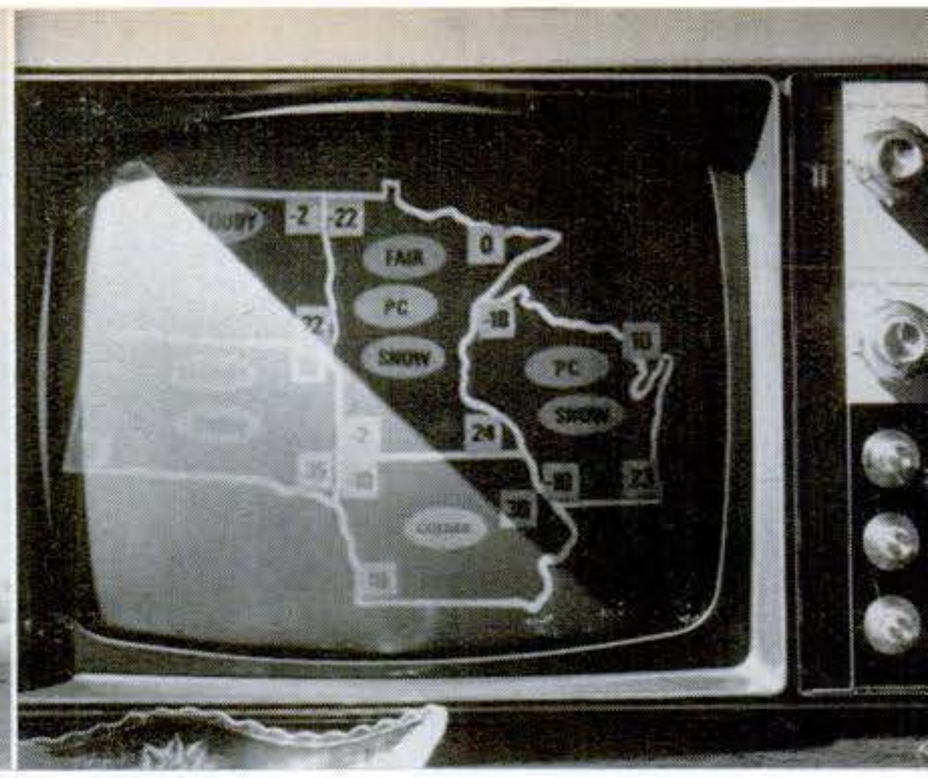
Facts about propane

Boiling point (liquid)	—44°F.
Flash point (vapor)	972°F.
Vapor pressure at 70°F.	109 psi
Flammability limits	2.4-9.5% of air
Weight of one gal.	4.2 lb.
Btu's per lb.	21,670
Liquid-to-vapor ratio	1:272



Tiny louvers are visible in this closeup of a strip of 3M's new polychroic light-control film (LCF). If film is seen at right angle, the light-controlling louvers disappear.

The center of this sheet of LCF is transparent, while the edges, viewed at an angle, become opaque. The angle at which a sheet will pass light depends on film thickness.



Black light-control film placed over the upper right half of a TV screen in bright light raises the contrast by blocking off ambient light that would bleach image.

New Polychroic Film Gives You Amazing Color Effects

This unique material uses microscopic venetian blinds to manipulate light

By A. J. HAND

I twisted the transparent pale yellow ribbon of plastic in my hands. One end turned a bright blue, the other flashed red. I flipped the strip over and twisted again. This time the yellow color suddenly changed to green and orange.

I was playing with a strip of 3M Co.'s new polychroic light-control film (LCF), whose color varies with the direction of reflected and transmitted light. Laminated inside the film are thousands of tiny louvers that control the passage of light like venetian blinds. Looking straight through the film you can barely see the edges of the louvers; the film assumes the color of the transparent base plastic. Angle the film slightly though, and the sides of the louvers start bouncing light back to your eyes. If the louvers are colored—say red—the film will suddenly become reflective rather than transparent as you twist it, and you'll literally see red.

The new polychroic film provides the homeowner a unique material for room dividers that transmit light, yet change color as you move about the room. It's ideal for hobbyists—it cuts with scissors; can be glued, drilled, and heat-formed.

Use it for a mobile with constantly changing color effects. Incorporate it in costume jewelry. It's a natural for eye-catching displays or for advertising.

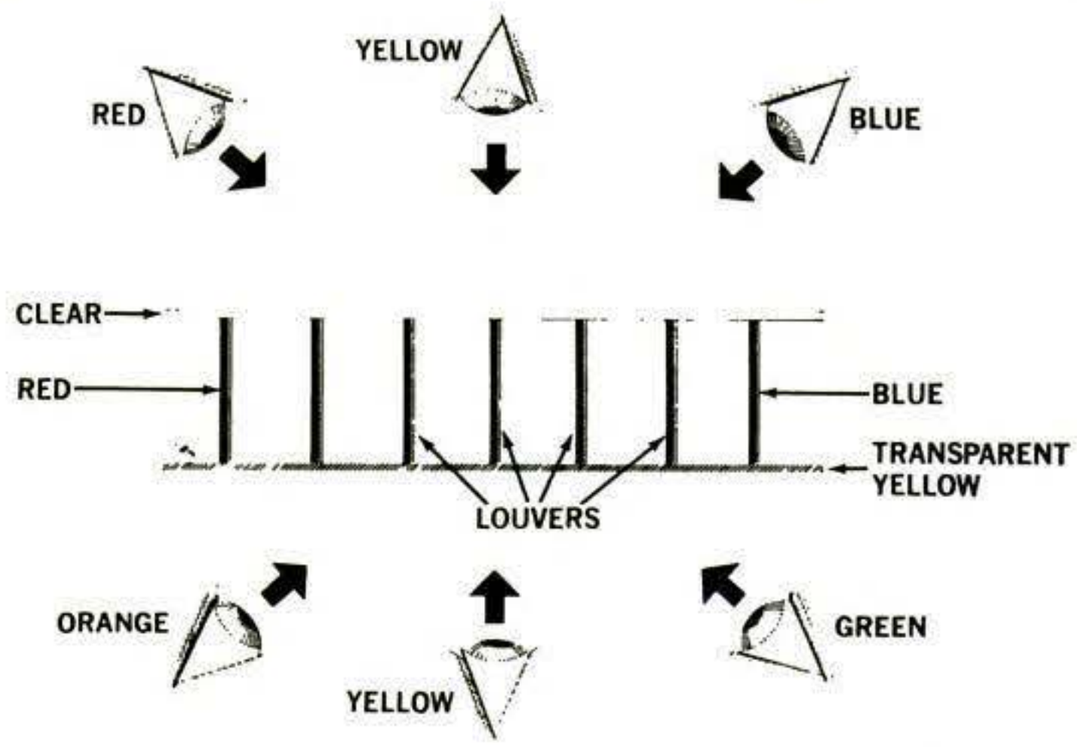
The 3M people make the LCF in a variety of forms, in both single and multiple colors. Single-color films come in red, blue, green, yellow, and black. Multicolored films put these colors together in combinations of twos, threes, and fives. Custom colors, slanted louvers, and matte finish are available at extra cost.

Small free samples of the polychroic film are available direct from 3M by writing: Light Control Film (220-11E), 3M Co., 3M Center, St. Paul Minn. 55101.

You can order LCF from the same source. Prices run from around $2.88 a square foot up, depending on the film thickness and color combinations. The minimum order is $25.

HOW IT WORKS

The multicolor effect in 3M's light-control film comes from the two-colored louvers laminated into the plastic base. A cross section of the film shown on the next page is diagramed at right. The louvers here are red on one side, blue on the other. The transparent yellow filter sheet on the bottom of the film makes the film look yellow when viewed straight on by transmitted light. If you view from above left, you see the red side of the louvers by reflected light, and the film looks red; from above right, you see the blue side. Look from below and to the left: the red looks orange through the yellow filter. From below right, the blue side of the louvers looks green through the yellow filter.



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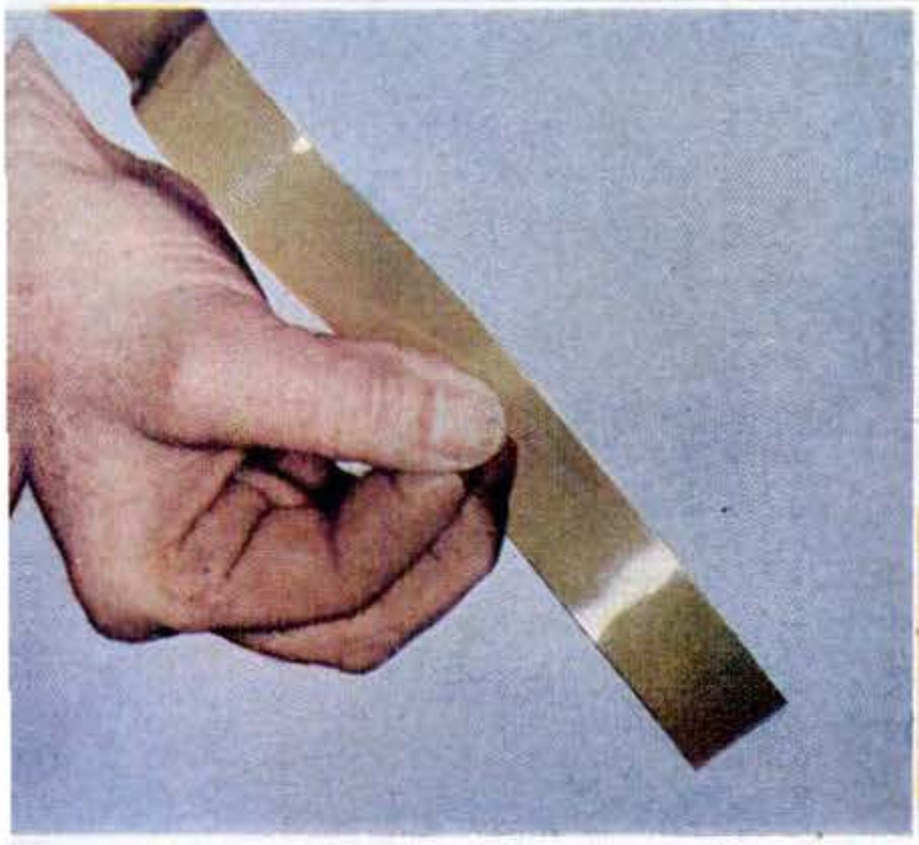

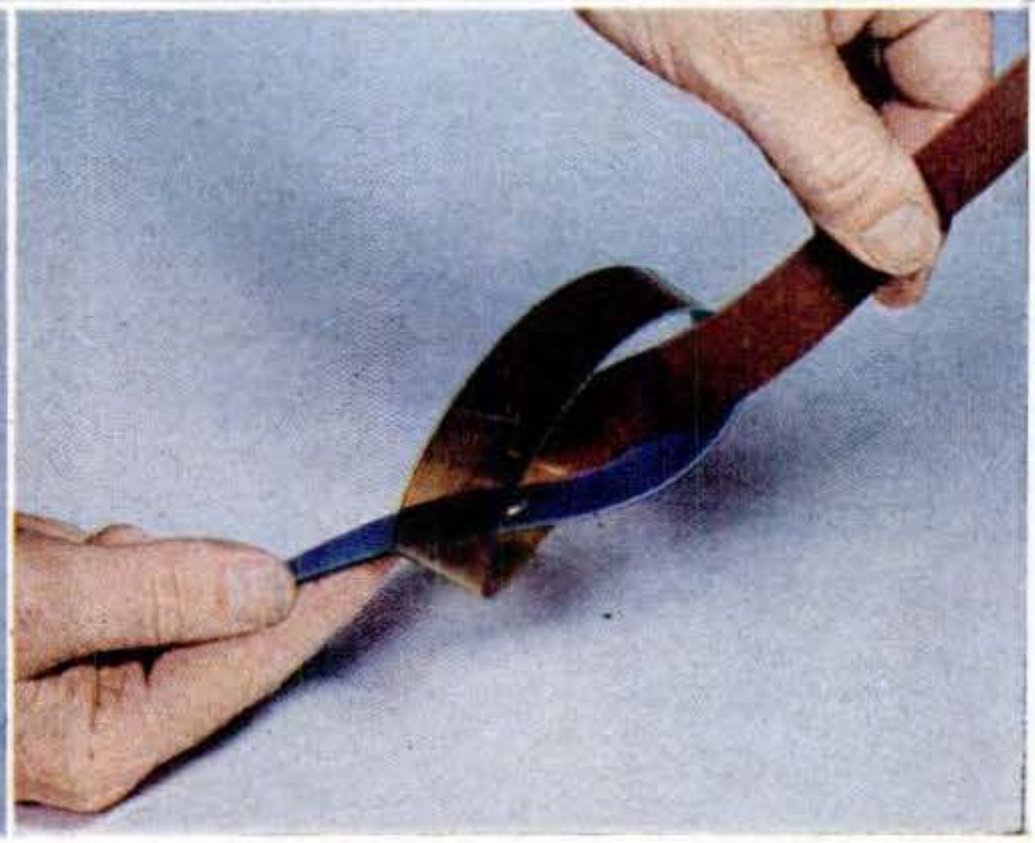

Start with the yellow strip, left, and tie it into a knot. As the number of viewing angles increases, the strip shows more colors, until a many-hued tangle is reached in the knot above. (Not all of the 3M films produce this many colors.) The diagram (far left) explains how the colors that you see here are generated.

COLOR PHOTOS BY A. J. HAND

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Sea-Floor Rover—

Master of All Trades Underwater

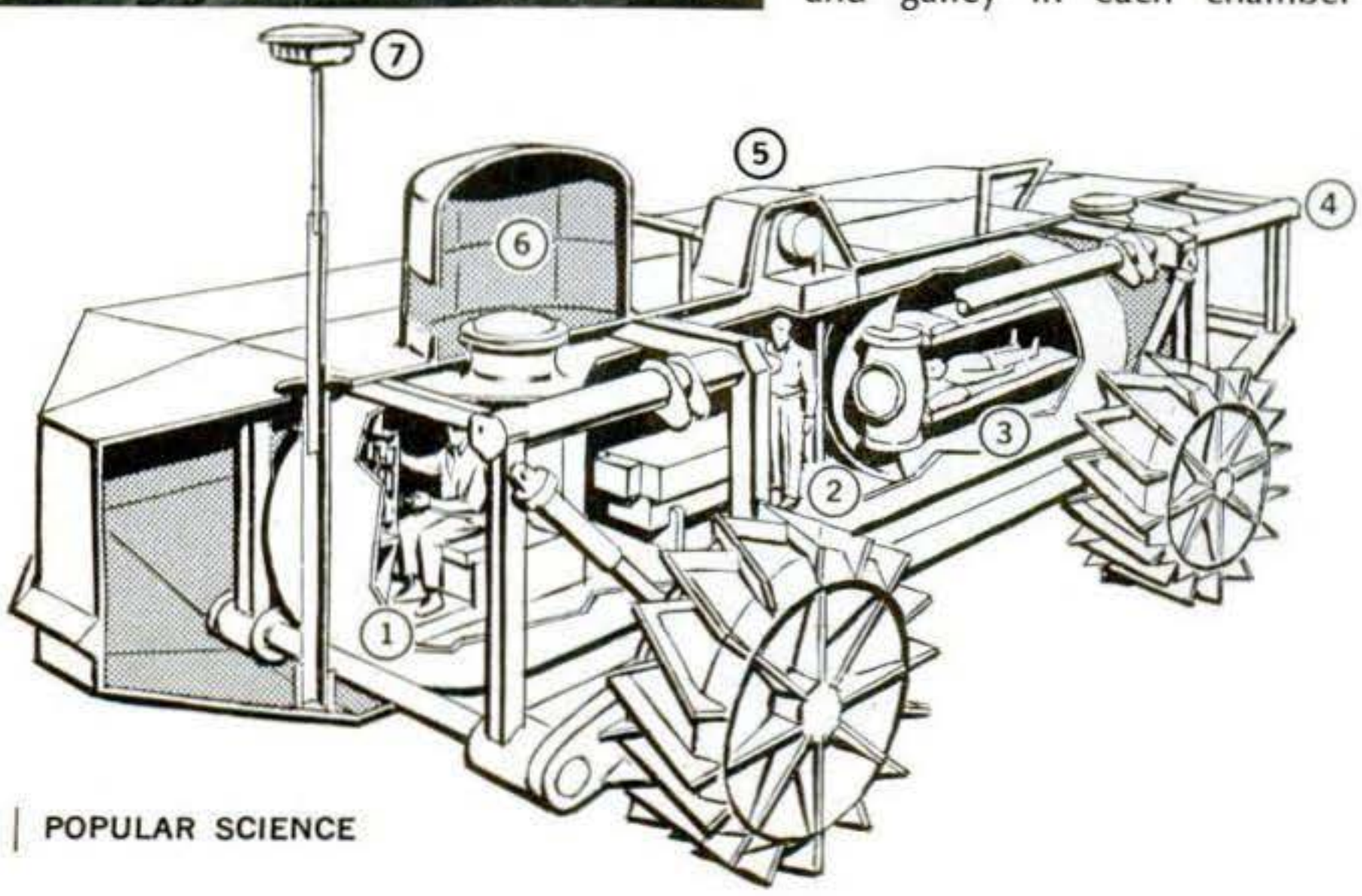
BY HERBERT SHULDINER

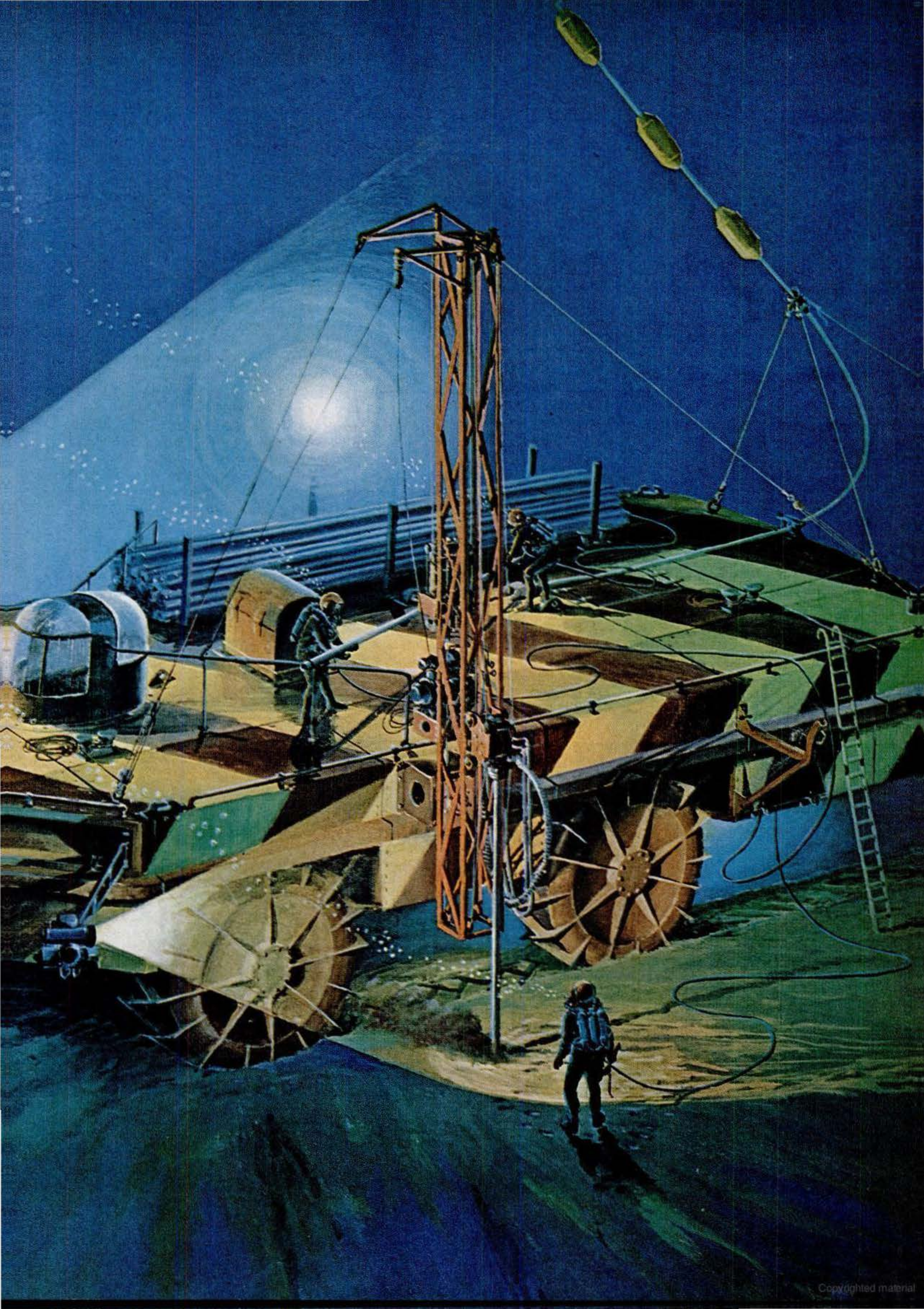
A giant undersea tractor that can roam the ocean floor at depths as great as 600 feet is about to provide a new dimension in oceanographic exploration. This sea-floor rover—called the Sea Bed Vehicle, or SBV, by its builders, Cammel Laird Ltd. of Birkenhead, England—is slated to undergo its first sea trials in December. It can ride over the soft, uneven ocean floor on its four huge wheels, giving aquanauts the kind of support and freedom they've never had before, for jobs like ocean-floor drilling, cable laying, mining, or as a base for diving over extended periods. Unlike free-swimming, deep-diving vehicles, the SBV is lowered by a support ship at the end of a cable which also supplies the umbilical links to the mother ship for power and communication.

Once this 60-ton vehicle reaches the ocean floor, however, it is self-powered, with a direct-drive motor in each wheel. A dead-reckoning navigation system, two TV cameras, and a high-resolution sonar help the operator guide the rover. It can carry two persons in the control cabin, plus three divers, and support them for five days before re-surfacing. Top speed? One-and-a-half knots.

Salvaging a wrecked ship (left) will be one of the jobs aquanauts will handle from the Sea Bed Vehicle. Undersea rover will be tested at end of this year

Inside look at the Sea Bed Vehicle below shows: (1) control room; (2) isobaric chamber; (3) hyperbaric chamber; (4) exterior frame; (5) winch housing; (6) free flooding observation cockpit; (7) sonar. The rover is 19 feet wide, stands slightly over 16 feet high with wheels extended for ocean-floor travel. The wheels are eight feet tall, three feet wide. Payload is 9,000 pounds. Afloat, it has a seven-foot draft, 101,000-pound displacement. There's a toilet and galley in each chamber





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For your wagon,

Three above and two below (with mattress on bed of wagon)—five travelers are set for sleeping. With lower mattress stored up top in camp, there's walk-through into vehicle.

Lightweight cap rests on hinged panels that flank the split door. Hinged side panels fill in forward triangle. Rear openings can be screened or provided with sliding windows. Folded for travel, below, rig has just reached its destination—Miami Beach.

Clamshell design provides a low profile for travel, plus in-camp head room in galley

By J. R. FUND

Since the major family travel vehicle is the station wagon, isn't it more logical to perch a camper on *it*, rather than on a truck? As a suburbanite, I had no need for a pickup, but wanted to cater to my family's wanderlust, without the bother, uncertainty—and expense—of nightly motel stops.

When I proposed a station-wagon camper to POPULAR SCIENCE, I was asked to design and build such a unit, but warned that I'd have to prove its practicality in actual use.

I've just returned (to northern New Jersey) from a 4,000-mile trip to southern Florida, and my wife and children are as enthusiastic as I am about this new concept in family travel. Since I'm only an amateur workshopper, I'm convinced you can build such a rig for your wagon as easily as I did—in time for adventuring this summer.

What my camper adds to the wagon is penthouse sleeping for two or three more travelers, stand-up head room for dressing, washing, and cooking—plus a handy galley for food storage and preparation which you can snug up to roadside or campsite picnic tables.

And all this is packed into a unit that weighs only 225 pounds and (equally important) folds down to a low travel profile that assures minimum wind resistance and lets you park the rig in your home garage.

It's a two-unit camper. You can load it on your wagon, one unit at a time, with only one helper. The loading (or unloading) takes only 15 minutes. And at a campsite, setting up your camper for cooking and sleeping takes one person less than a minute. For travel, you can store your clothes in garment bags laid flat under the cap.

The Ford Motor Co. graciously lent me a new Country Squire LTD around which to design the rig, and to take on my test run. The only thing I asked for, beyond basic equipment, was a set of air bags added to the rear springs to keep the wagon from bottoming over railroad tracks and road dips.

You can tailor the rig's dimensions to fit any wagon. You don't even remove your tailgate. In its lowered position, it helps support the galley section that slides in over it. And you don't mar the wagon in any way by installing the camper. The overhead sleeper mounts on a standard

Continued

build this POP-UP CAMPER

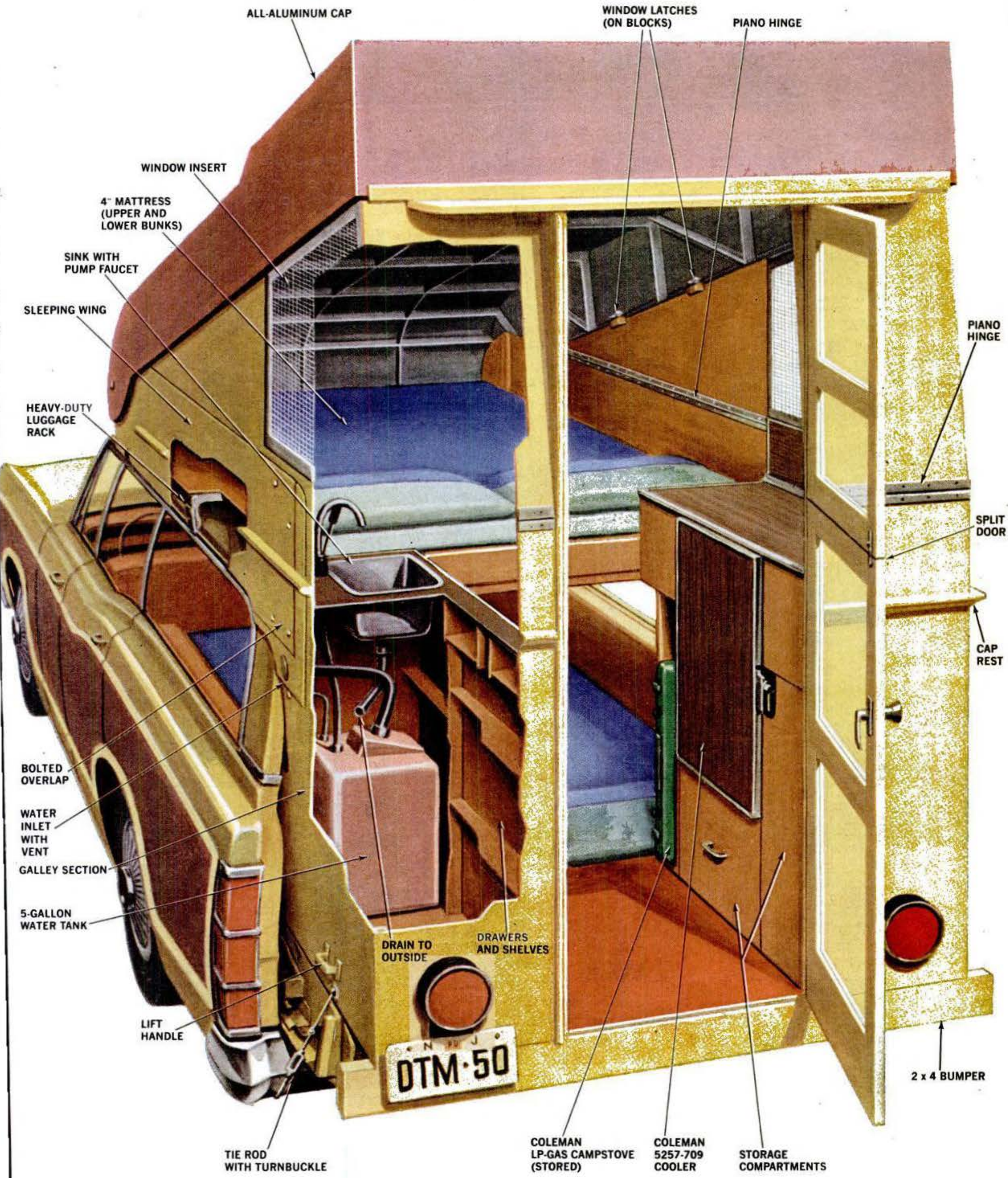

ILLUSTRATION BY RAY PIOCH

For information on how to order working drawings, turn page

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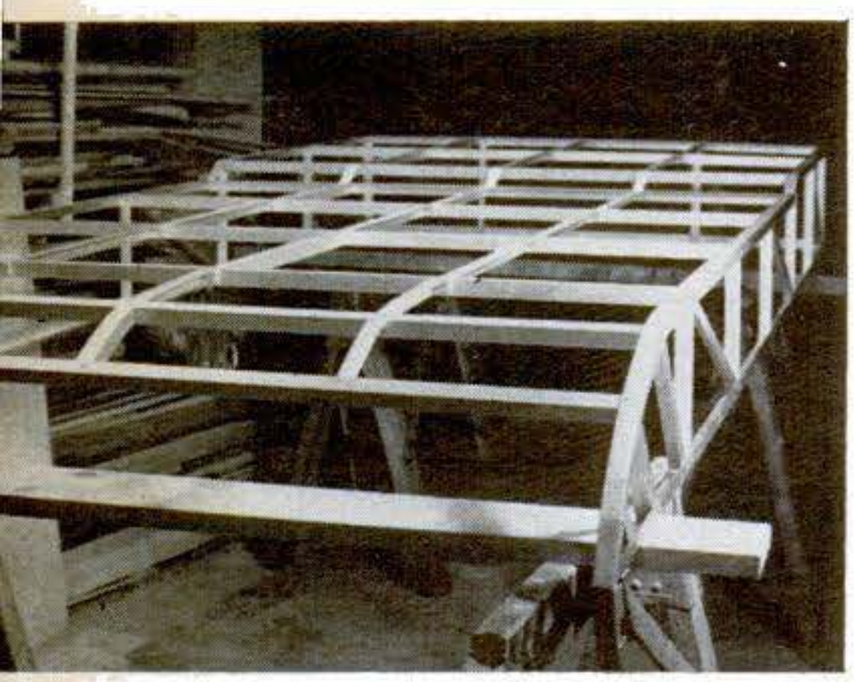
Loading the camper is as simple as 1-2-3

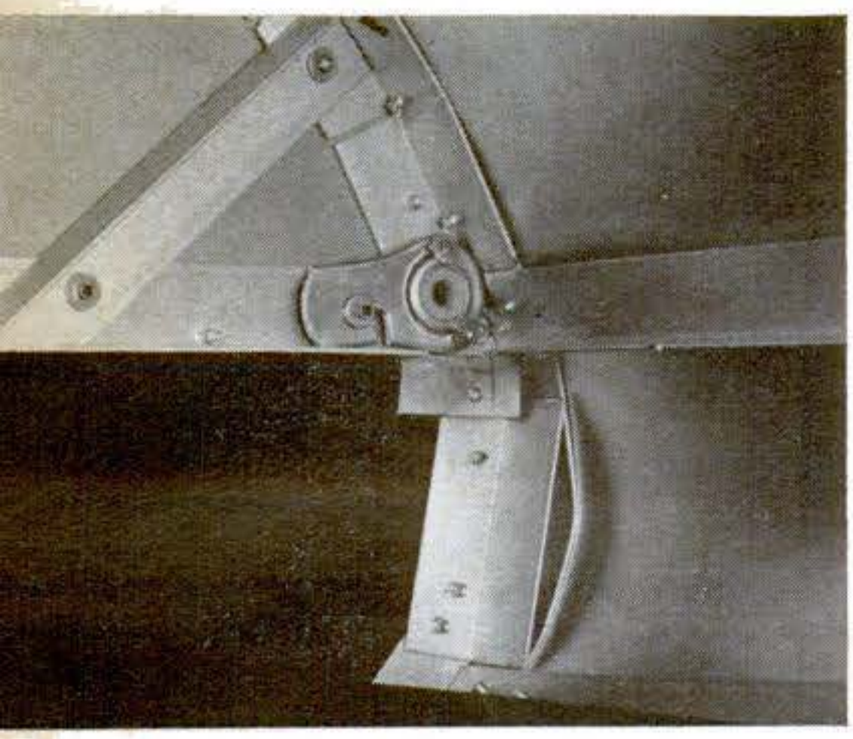
Lift sleeping wing into approximate position atop wagon. All bearing surfaces are faced with rubber. Time: three minutes.

Slide galley section in over tailgate, lifting with handle. Note self-positioning overlap section. Bolting time: eight minutes.

Slip aluminum cap atop sleeper and insert two pivot bolts at front. Time: four minutes, for total loading time of 15 minutes.



Frame of cap, prior to covering, shows ribs of 1"-by-1" aluminum angle. Airfoil curve is formed by slitting one leg (photo below).



Nylon bearing from a backyard swing is adapted for use as front pivot, each side of cap. Aluminum skin has been added.

Author in workshop bevels sides of sink cutout with rasp so stainless-steel unit will set flush with laminate countertop.

luggage rack that clamps onto the rain gutters; the rear of the galley section is anchored by means of tie rods that hook under the bumper.

The cutaway illustration on the previous page shows relative locations of galley storage spaces, sink, stove, and ice box.

Building the camper. Construction is straightforward and strong, calling for only readily available materials such as plywood and aluminum. The unit was carefully designed toward this end. The sink, faucet, and fittings for external filling and drain can all be purchased from a marine-supply store. Piping is flexible PVC type, secured with stainless-steel clamps. The water tank is a plastic five-gallon jerry can.

Since your camper will be subjected to all types of weather, wind buffeting, and constant twisting and racking on the road, take care that all joints are glued and screwed carefully; a waterproof resorcinol glue is best, but plain white glue will do.

Plywood should be marine type, finished two sides, even though all surfaces will eventually be sealed and painted. (Avoid plywoods marked "Glued with waterproof glue" or "Exterior glue used"; these are not honest outdoor materials.)

All screws should be cad-plated; rivets, aluminum; and all paints, exterior type. Since there are several gross screws to be driven, I recommend an automatic-return driver, a brace with a driver bit, or an attachment for your electric drill. All construction was done with standard hand and portable power tools.

While most dimensions can be altered to fit the tailgate and opening of another model station wagon, do not change the airfoil shape at the front, or the offset toward the back of the aluminum cap. The front curve was designed to allow air to pass over it with the least resistance, while the offset "grabs into" the flow; this tends to depress the unit and keeps the back of the vehicle from "floating" at high speeds. Air that is directed under the sleeping wing is immediately "spoiled" by the deflector located just back of the leading edge, to cancel

[Continued on page 112]

How the rig handles—

a report from our Auto Editor

You may wonder how the camper affects handling and controllability of a station wagon. I drove the rig on freeways, winding rural roads, and in suburban traffic. I found nothing unsafe in its behavior, but you must keep in mind that you're not driving a passenger car. It's a camper, and you should treat it like one.

Altered weight distribution produces an oversteering tendency that increases as speed rises. Change in aerodynamic shape has made the vehicle more sensitive to crosswinds. No sudden directional changes should be made at high speed. When changing lanes at turnpike speeds, plan the move well ahead, then ease over. Avoid braking hard except when traveling in a straight line.
—*Jan P. Norbye*

How to order PS Project Plans

Dimensioned construction drawings show you how to build the plywood and aluminum camper, complete with interior cabinetry. For a set of 17"-by-22" plans, send $3.95 in check or money order to Popular Science Project Plans (Pop-Up), 355 Lexington Ave., New York, N. Y. 10017.

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How to Weld with Your Lathe

When you spin one piece against another, the heat of friction causes a bond

By JAMES H. McVICKER

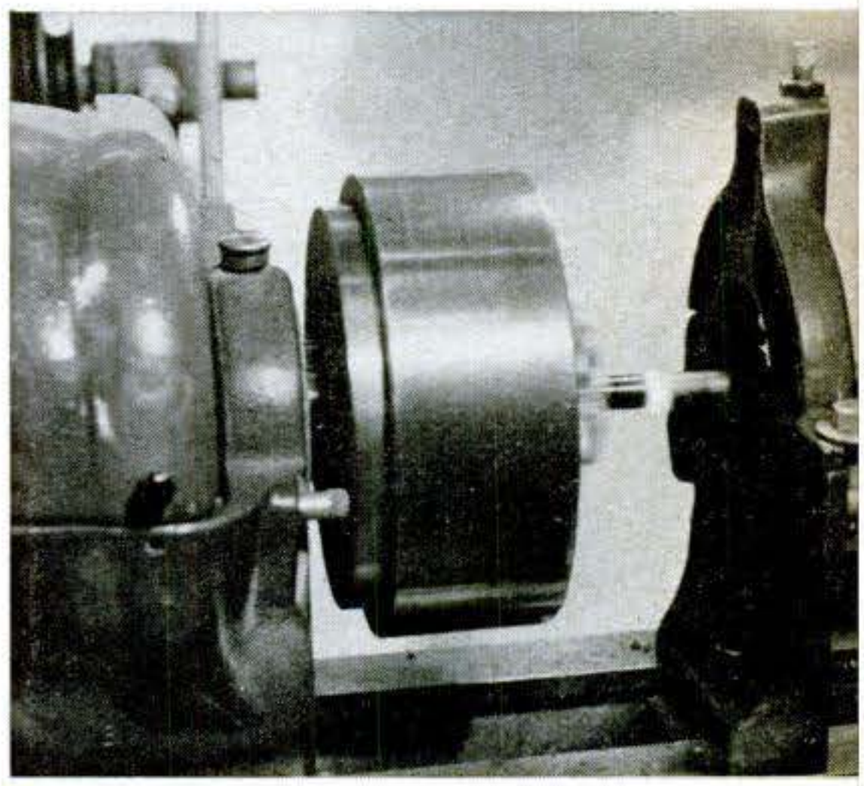
Weld with your lathe? You can on almost any small lathe—or even a drill press—without resorting to any heat source. Friction, or inertia, welding has been used in Europe for years. It works on most steel alloys, including stainless.

You mount one piece in the lathe chuck or on a faceplate and revolve it at high speed. You hold the other part stationary in a tailstock chuck and press it against the revolving part. In a few seconds friction will bring the contact area to a white heat. At this point you shut the power off and increase the pressure between the parts. When the rotating piece comes to a stop the parts will be securely welded together.

This is an ideal method for welding an extension to a drill. The drill will be in perfect alignment after welding. A 10″ lathe with a ½-hp motor will easily weld an extension on a ½″ drill. Experiment with a few pieces of rod first, however.

To secure perfect alignment, install a rod the size you'll use for the extension in both the lathe chuck and the tailstock chuck. Set the steady-rest bearings snugly against this rod, then remove it and set up drill and extension as shown. Cover the lathe bed to protect from flying sparks.

Set the lathe at the highest speed and feed the rod lightly against the drill shank. Do not use too much pressure before the parts become bright red, or they will stick, stalling the motor before producing a good weld. Keep a light pressure until the parts are white hot. Shut off the motor and increase the pressure until rotation stops. Grind or turn off the flash and you will have a perfect extension.



For drill extension, install drill in lathe chuck, shank extending an inch. Anchor rod in tailstock, support with steady rest.

Other shapes can be welded also, but parts should be of similar mass; otherwise the smaller part will reach welding temperature before the large one and become excessively deformed.

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You can mow your lawn at night and avoid the heat of the sun. Electric power provides light, and whisper-quiet operation.

Snow clearing is a snap with the Elec-Trak. There are no starting problems, even in winter. Extra-slow speed and a separate motor for the blower assure removal of the heaviest snow.

No hot manifolds and exhaust mean cool operation in the heat of summer. This tiller raises and lowers with Elec-Trak's lift. Like the mower and snow blower, it can be fitted to mower in seconds.

Fantastic ELEC-TRAK

Runs on Batteries, Powers Your Electric Tools, Too

PS tests the garden tractor that's going to shape up the power-equipment market

By E. F. LINDSLEY
PS Outdoor Power Equipment Editor

If you're wondering what it will be like to drive an electric car some day, you can get a preview right now by trying General Electric's brand-new electric tractor. And if you've also been wondering when someone was finally going to do something about the air and noise pollution that surround suburban lawn chores, here's your chance to be that someone.

Make no mistake—this is an all-electric tractor that's on the market now! Not a pilot model, not a low-production, market-testing prototype, the Elec-Trak is in the lawn- and garden-tractor market with all four wheels solidly on the ground and with five years of test models behind it to insure bugfree performance.

Even better, the price is right—just about in the middle of the 10,- 12,- and 14-hp price range, depending on the size you buy. You pay no premium for electric power. Here's what you get:

- Full power to equal gasoline.
- Torque better than gasoline.
- Separate motor power on mower, snowthrower, and tiller.
- No starting problems.
- No fuel problems or hazardous gasoline handling.
- No tune-ups, spark plugs, or hot manifolds.
- No noise, fumes, belts, or chains.
- A rolling power source for other yard tools.

What's the catch? If there is one, I didn't find it in test-driving the Elec-Trak. You'll be able to drive one yourself shortly, but hop aboard with me now. I'll take you on a test run so you can see how it goes.

Speed: seven mph. GE says the tractor is designed to fit the human body. You'll find that the seat, leg room, control placement, brake, steering, and visibility seem natural all around. Reach left and thump home the main circuit breaker to make all circuits "go." Turn the safety key that keeps the kids from unauthorized use, and choose your gear.

Low-low is very low indeed. High (D-2, it's marked) will take you over hill and dale at seven mph—faster than needed for most work. As you drive you'll find that even in D-2 you can throttle back to a crawl and still have loads of torque. This torque has a profound effect on tractor operation —more on that later.

For the time being, go ahead, dump the throttle wide open—there's no clutch to fool with. You'll hear a quiet hum as the tractor moves ahead. For a moment, you'll be surprised; this isn't quite the surging power you expected. But within a second you'll hear a low click and the speed will increase. A quick series of these clicks and acceleration periods, and you're under way at full speed.

GE calls this "programed starting." Why have it? For safety. Talking to Bruce Laumeister, who has headed GE's long-range electric-car development project and is father of the Elec-Trak, I gathered that early tractor models were bombs on takeoff. It figures. Electric motors have maximum torque at stall. Unlike a gasoline engine, an electric can light out from scratch with lots of scramble. Starting up a hill, too sudden acceleration could flip a tractor onto its back. Programed starting prevents that.

The Elec-Trak's little helpers

Electric drill, designed specially to run off Elec-Trak's 36-volt powerpack, lets you make repairs anywhere in your yard.

Electric hedge clipper, like other tools made for use with the tractor, impressed the author with its power and performance.

Garden fogger runs off the tractor's 36-volt pack, too. The low-voltage power system is well below the shock-hazard level.

Electric edger makes yard care easy. Standard 115-volt tools can be used, too; you run them off an optional inverter.

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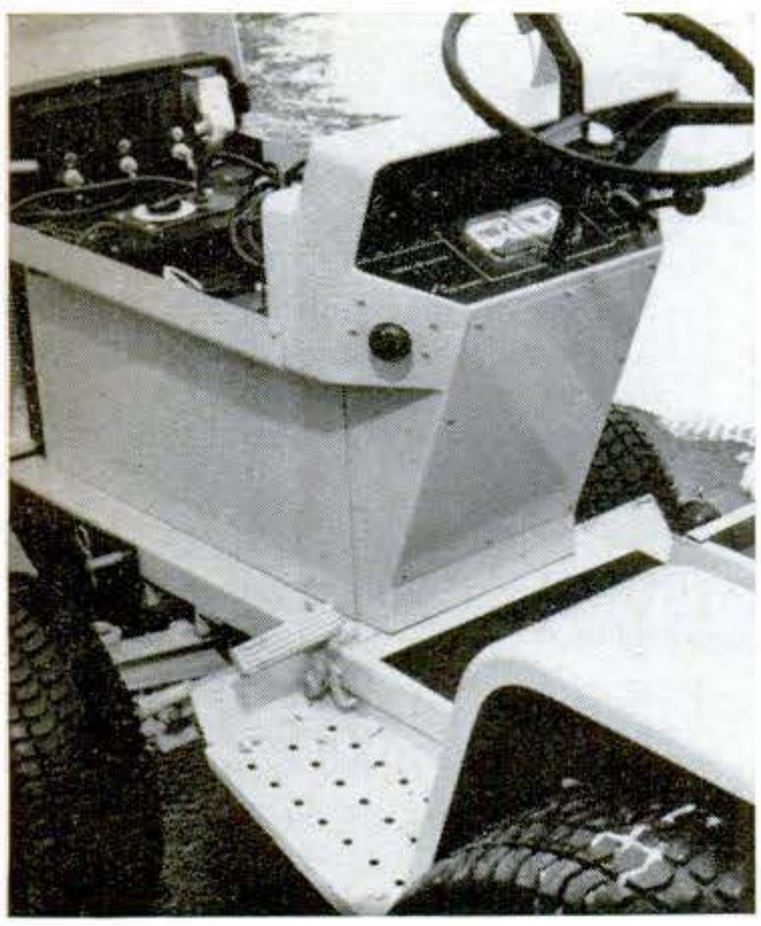
The "fuel" gauge. Once you get the feel of the Elec-Trak, take a look at the instrument panel. You'll see a "fuel level" gauge, which in reality indicates the level of the battery charge. A second gauge shows how much power you're pulling. Maybe in the wrong gear and the right circumstances you could force the needle into the red. I never did and I tried hard to make the machine sweat.

Potent DC welder operates so smoothly from the Elec-Trak's powerpack that even amateurs will be able to lay clean beads.



Solid-state controls are housed beneath the instrument panel (above). Lifted front hood (below) reveals the charging equipment and part of the battery pack. Coiled cable plugs into household outlet for charging when the tractor is not in use.

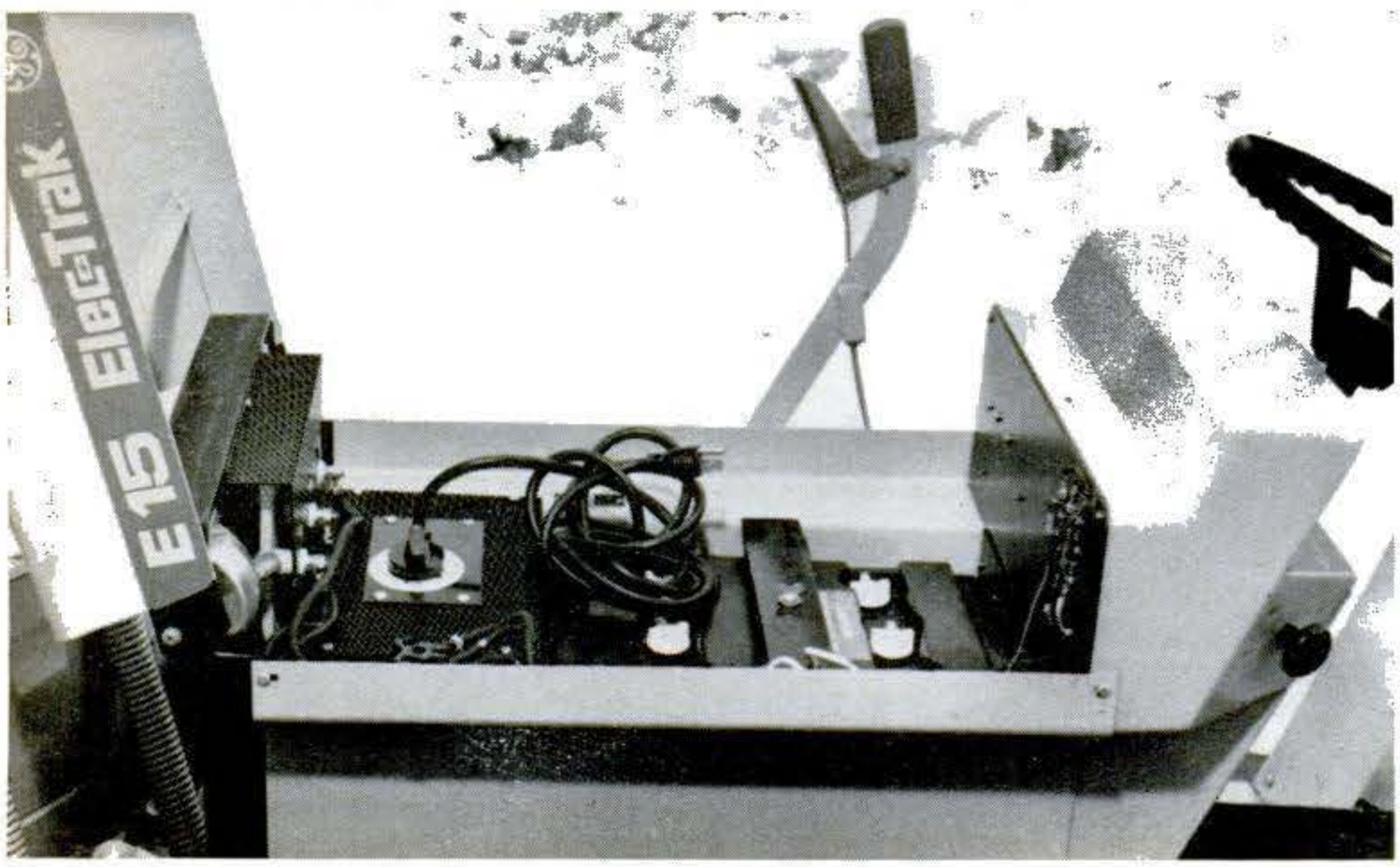
Flick the switch just to the left of the gauges. A built-in electric lift will raise the front-mounted mower, or snowthrower or dozer blade. The lift is standard on all models. My only real criticism of the tractor is the size of this switch. Cutting grass on a warm day, the size is fine; but trying to jockey a snowthrower with your hands in mittens is an all-thumbs fumbling session.

Now flick the implement power lever. You'll hear another steady hum —unless the wind is blowing or the birds are chirping loudly; the mower is really that quiet. Of course, you can hear the blades on the 42-inch mower, but it's a low fluttering noise. Your neighbor will never know you're cutting grass.

When you're satisfied that the Elec-Trak really works, and you've become accustomed to the silence, try some hills and rough going. The tractor has amazing traction and handling. About that torque I mentioned before: Hills and heavy loads won't slow the Elec-Trak down. Confidential GE films (which you'll never see) show Elec-Traks pulling conventional tractors of equivalent power backwards, with their wheels spinning. And this with three extra men standing on the conventional tractor for extra traction.

Safety is built in. The Elec-Trak has some more surprises in the field of safety. The safety interlocks on the tractor are a silent testimony to the engineer's efforts to outguess even the most careless user.

Flip off the mower switch. The motors and blades stop almost instantly. Three seconds is the maximum coast time, even for mower cutters swinging free in the air. Over grass, they stop almost instantly.



Bounce up off the seat. The tractor and mower will stop dead. Picture yourself momentarily bounced overboard. The tractor would stop. If, while trying to scramble back into the seat, you closed the weight-sensing switch underneath it, the tractor would not move; a seat-only circuit breaker offers too much chance of running over the feet or legs of someone trying to regain the seat from an awkward falling position.

So, to get moving again, you must once more be seated properly, deliberately turn off the switch, close the throttle, and reset the controls. In short, the tractor makes you tell it specifically what you want it to do. Cross it up in an unsafe manner and it's programed to stop like a wise old horse.

Unplug it and go. If the Elec-Trak could do nothing but cut grass, plow snow, and till soil, it would still be welcome news. After all, nobody enjoys fooling with gasoline, oil, belts, and starting problems. The closer a piece of equipment comes to a refrigerator in the "convenience of owner neglect," the better. That's another Elec-Trak strongpoint. Plug it in when not in use—it takes care of its own fuel needs. Unplug it and you're ready to go. Half-charge takes three hours; full-charge, five to six. You'll have to dribble a smidgen of tap water into the batteries about once a month during the summer. In winter, plug it in and forget it till you need it. Cold outside storage? The batteries love it. When you want to move snow, you'll have no starting problems.

Add to that the fact that the Elec-Trak is a willing, portable source of plug-in power anywhere you drive it. Edging, clipping, tilling, hedge trimming, drilling, grinding, or spraying —all are available in a complete line of hand tools wired to run on the tractor's supersafe 36-volt system. There's also a powerful arc welder, priced at under $100.

Another convenience that shouldn't be overlooked is the mounting of the front mower deck. This, and other implements, hang on what GE calls a "stab" mounting. You simply stab the mounts into frame channels at the front or rear of the machine. Obviously it's a lot easier to push in an electric plug than to rig belts, chains, or drive shafts.

You'll appreciate the flip-top rigging of the mower deck, too. An easy lift on the front edge turns it up for full access to the cutter blades. A bonus is possible here if you buy an electric drill with a grinding attachment. Keening up the blades takes only a flip of the deck and a few min-

[*Continued on page 118*]

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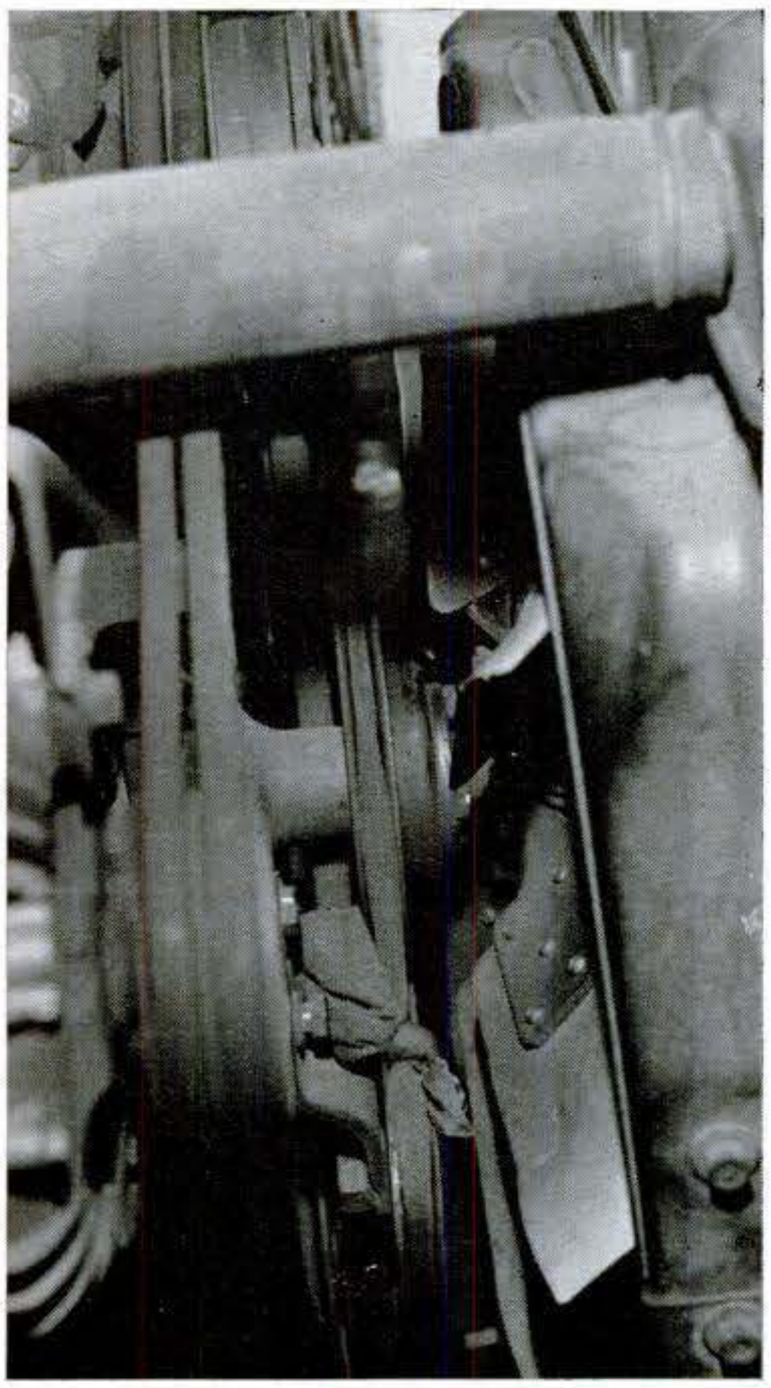
Taking Care of Your Car

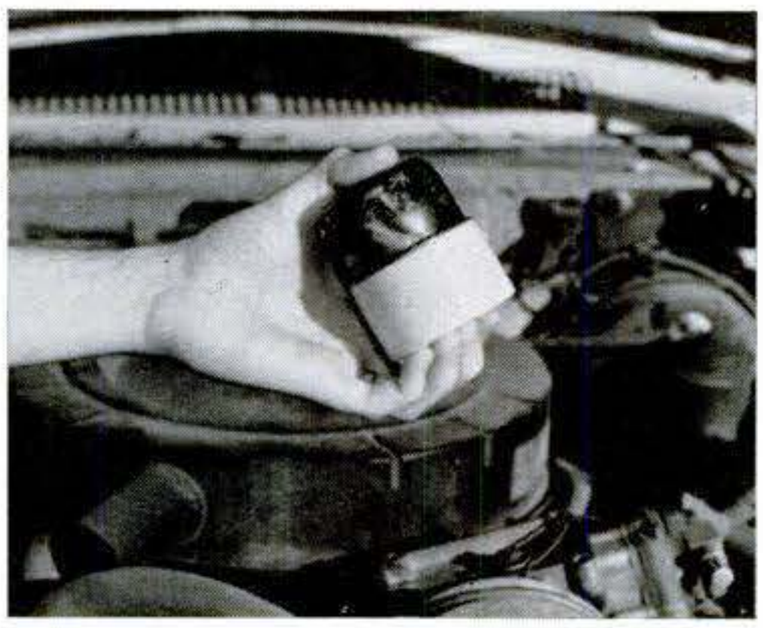
Good hints others have used

Got a car tip? We pay $25 for each one accepted. Send it to Car Care, POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017. None are returnable.

When a small crack develops at the edge of a windshield or backlight, you can stop it before it spreads and ruins the entire piece of glass. Chuck a piece of 1/8" or 3/16" copper tubing into an electric drill. Dip the end of the tube in coarse valve-grinding compound and, using light pressure on the drill, cut through just the first layer of the glass. Fill the hole with plastic body filler, or cover it with a decal. This should stop the crack in its tracks.



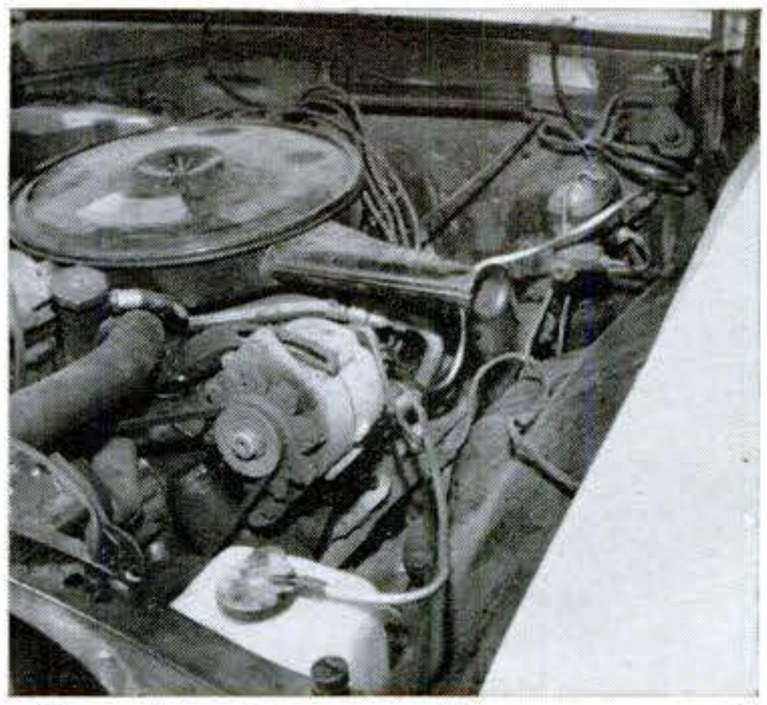
Should your fan belt break while you're on the road, a nylon stocking will work as a substitute belt until you can get to a gas station. Just loop the stocking around the pulleys and tie it tightly.



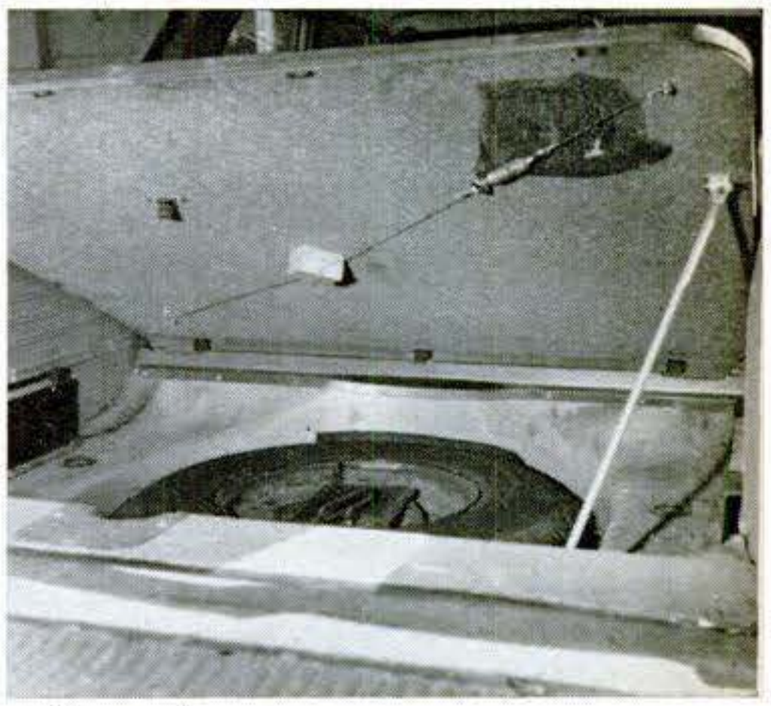
To clean a dirty oil breather cap, take a plastic cap from an aerosol spray can, fill it with solvent, snap it onto the dirty cap and shake well. The oil breather cap comes clean with no mess.

To remove small roof dents, why remove the headliner? Poke an ice pick through the liner to center of the dent. Tap gently with a small hammer and the dent will pop out. The tiny liner hole won't show.

Wires to door-mounted stereo speakers often break due to repeated kinking. You can add some protection by running them through a 6" section of screen-door spring. Thread the spring ends into holes drilled in the door and the body of the car.



Add a piece of copper tubing to your windshield-washer hose, and run it near the exhaust manifold. This will warm the wash water and you'll get cleaner windshields, long blade life, and, come winter, quicker removal of ice and snow from the glass.



Pull out the warp in a station-wagon storage-compartment lid with a turnbuckle and a piece of wire. Attach the wire to flathead machine screws in opposite corners and run it over a notched block of wood in the center. Tighten until the metal lies flat.

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Here They Are: Results of the

By ERNEST A. ZADIG

It's over! William J. Hawkins of North Brunswick, N.J., is the winner of the $20,000 first prize in the POPULAR SCIENCE Anti-Car-Theft Device Competition sponsored by the Allstate Insurance Company.

The seven-man panel of judges had a tough time picking the winners from among the more than 2,000 entries. Over 100 of the working models submitted showed a remarkably high level of ingenuity, technical competence, and workmanship.

Second prize of $2,500 was awarded to Donald C. Peroutky of Schenectady, N.Y.; the third prize of $1,000 to W. D. Lothe of Covina, Calif; and the $500 fourth prize to David L. Pippen of Las Cruces, N.M. The winners of the 10 additional $100 prizes are listed in the box at left.

POPULAR SCIENCE will place the Hawkins invention in the public domain and grant any responsible manufacturer a royalty-free license to make the device, in the hope that its use will reduce the annual toll of more than one million stolen automobiles. Reasonable cost and ease of installation bring general adoption of the device within the realm of possibility.

The winning entry. William Hawkins calls it an "improved electronic locking system." The usual car key is replaced with two slips of plastic, much like credit cards. One is for the owner's exclusive use; the other for garagemen or parking attendants.

The two cards for the model submitted have entirely different patterns of holes, so that one cannot be substituted for the other. (Raised or indented characters could take the place of the holes if it would make manufacture more convenient.)

The owner's card permits unrestricted use of the vehicle, unlocking compartments such as the hood, glove box, and trunk, too. The attendant's card, however, allows only starting and stopping—with continuous flashing of four turn signals. The blinking is designed to attract attention to unauthorized operation off the parking lot. Any fooling around by the garage driver in an attempt to overcome the protective system stalls the car dead, and even sets off an alarm if desired.

The Hawkins device consists of two parts, one on the instrument panel and the other under the hood. They are connected by a multi-wire cable passing through the fire wall. Any "jumping" of these wires immediately kills the circuits and avails the would-be thief nothing.

The instrument-panel unit is the size of a pack of cigarettes. It functions as the "reader" into which either card is inserted and also carries three pushbuttons marked *Code, Hood,* and *Start.*

Insertion of a proper card (owner's or attendant's) turns on the ignition and activates the *Start* button so that when it's pushed, the starter turns over the engine. Removing the card shuts off the engine.

Here is where the difference between the two cards becomes apparent. The attendant's card leaves the other buttons dead. But it turns on the flashers.

The owner's card turns on the ignition (minus the flashers) and also activates all *three* buttons. A push on the *Hood* button now releases the electric latches on hood, glove box, and trunk so that each can be opened manually and reclosed.

The *Code* button is a unique part of the system. Push it before removing your card and you change the receptivity of the circuit so that it will accept the attendant's card for starting the car. But the card will not work unless the owner readies the circuit to accept it. Therefore, surreptitious duplication of the atten-

[Continued on page 114]

Here are the winners of the Popular Science Anti-Car-Theft Device Competition sponsored by Allstate Insurance Company:

1st PRIZE . . . $20,000
William J. Hawkins, No. Brunswick, N.J.

2nd PRIZE . . . $2,500
Donald C. Peroutky, Schenectady, N.Y.

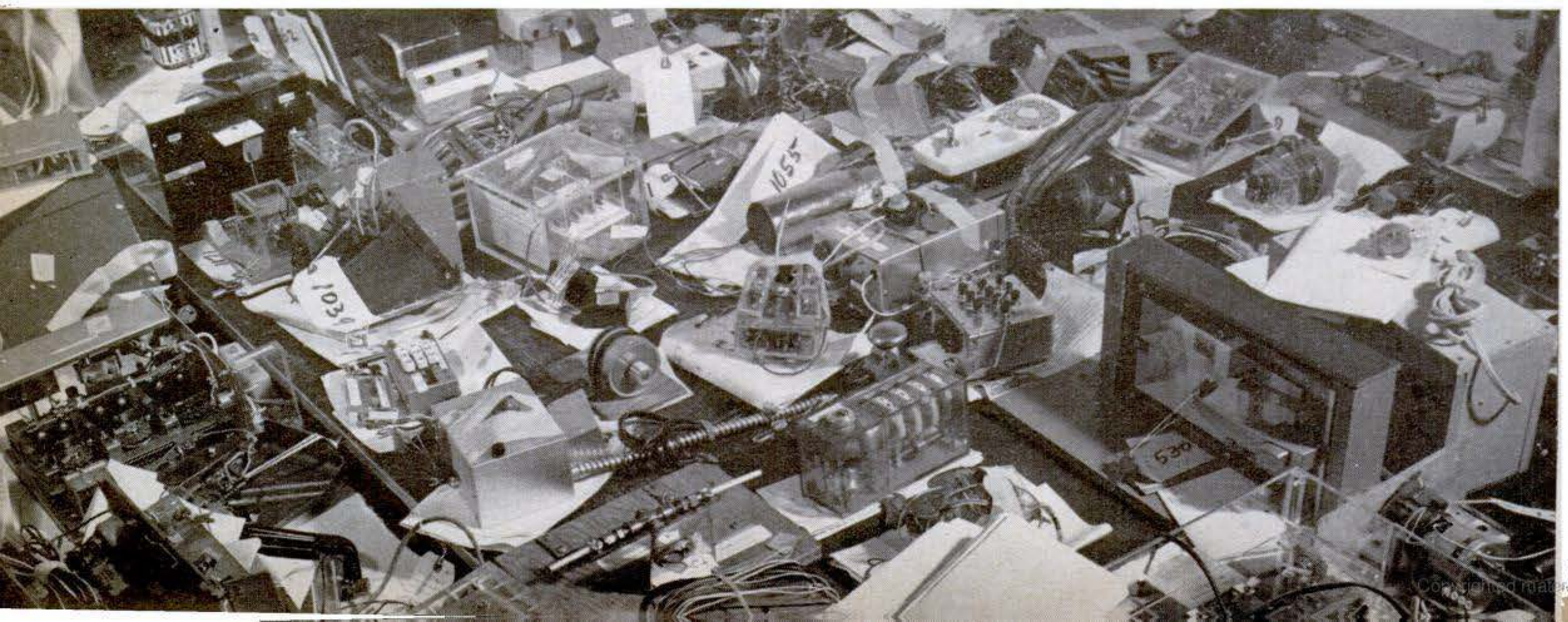
3rd PRIZE . . . $1,000
William D. Lothe, Covina, Calif.

4th PRIZE . . . $500
David L. Pippen, Las Cruces, N.M.

10 PRIZES of $100 EACH

Harold G. Alles, Eugene, Ore.
Robert T. Bardsley, Hamilton AFB, Calif.
Carlos R. Carman, Memphis, Tenn.
Paul H. Hofhine, Salt Lake City, Utah
Gerald L. Jackson, Monroeville, Ala.
James W. Law, Reynoldsburg, Ohio
Robert N. Liang, Poughkeepsie, N.Y.
Robert McAra Murray, New York City
John A. Racki, Milford, Conn.
Martin W. Westland, Bozeman, Mont.

This array of ingenious gadgets includes all the finalists in the Popular Science Anti-Car-Theft Device Competition. The smallest



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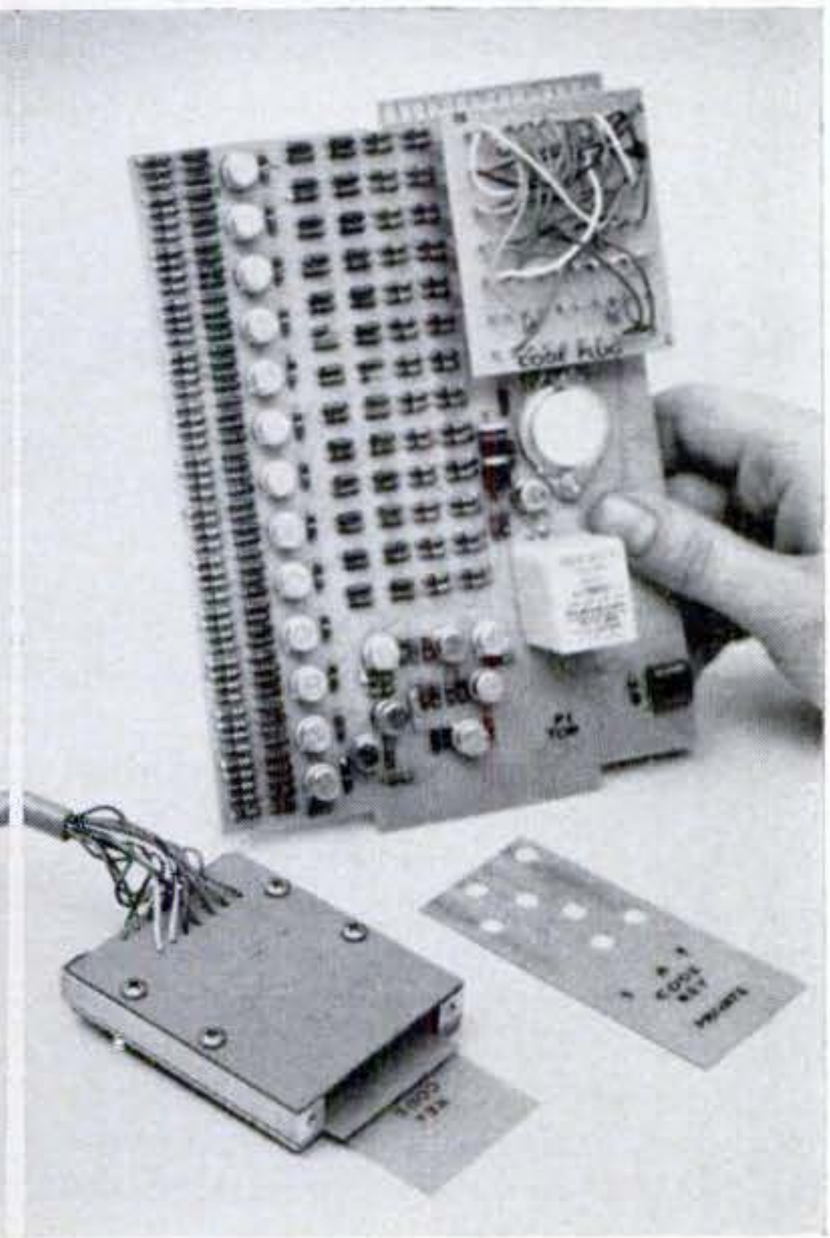
$25,000 Anti-Car-Theft Competition

Ernest V. Heyn, Editor-in-Chief and Associate Publisher of Popular Science (right) congratulates William J. Hawkins, first-prize winner in Anti-Car-Theft Device Competition, as Mrs. Hawkins and Robert Leys, vice-president of the Allstate Insurance Company look on. Hawkins' device (below) is an improved electronic locking system.



The Winner

William J. Hawkins, winner of the $20,000 first prize, is an inveterate electronics gadgeteer, and everything from his home to his car bears signs of his ingenuity. A converted closet off the living room is the "workshop" where all his ideas take shape.

The output of the hi-fi stereo is piped into all rooms; the input is governed by an automatic switching system that can choose or mix FM, tape, and discs. Blinking green, yellow, and red lights monitor the circuits and warn of irregularities.

An intruder hapless enough to pick the Hawkins home will have his presence sensed electronically and immediately reported to a nearby relative via the telephone. An outbreak of fire would cause a similar alert and the sounding of a loud local alarm.

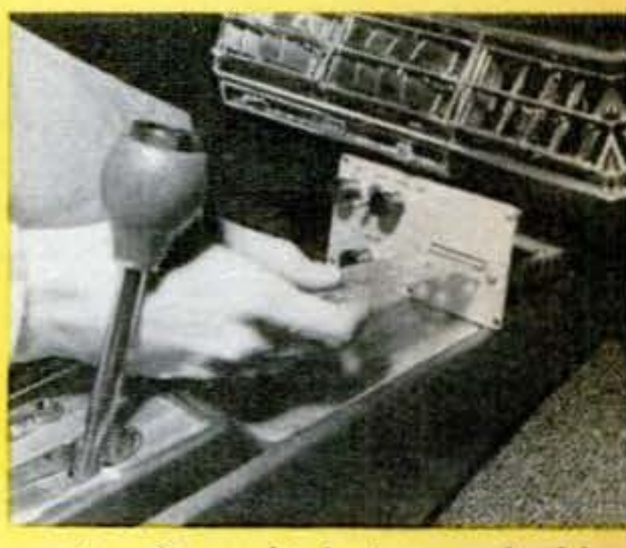
The Hawkins' car announces its whereabouts in a vast parking lot when they return to look for it. It does this by blinking its lights and beeping its horn in response to a signal from a tiny radio transmitter. And there is a burglar alarm, this one with a secret shutoff.

"It took plenty of midnight oil," admitted Bill Hawkins, elated when advised that he'd won. The device that captured first prize was his third construction for the competition.

The first model made no provision for parking-lot operation. The second attempt provided a switch for this purpose hidden under the hood. This was deemed too messy to be acceptable by car owners, so was scrapped. The third model, which tied up all loose ends, is the one that was entered in the Popular Science Anti-Car-Theft Device Competition.

Bill Hawkins, 24, studied electrical engineering at Bridgeport University. He is an electronics technician at RCA-Astro in Hightstown, N.J., where he is involved in the testing of spacecraft and Tiros weather satellites.

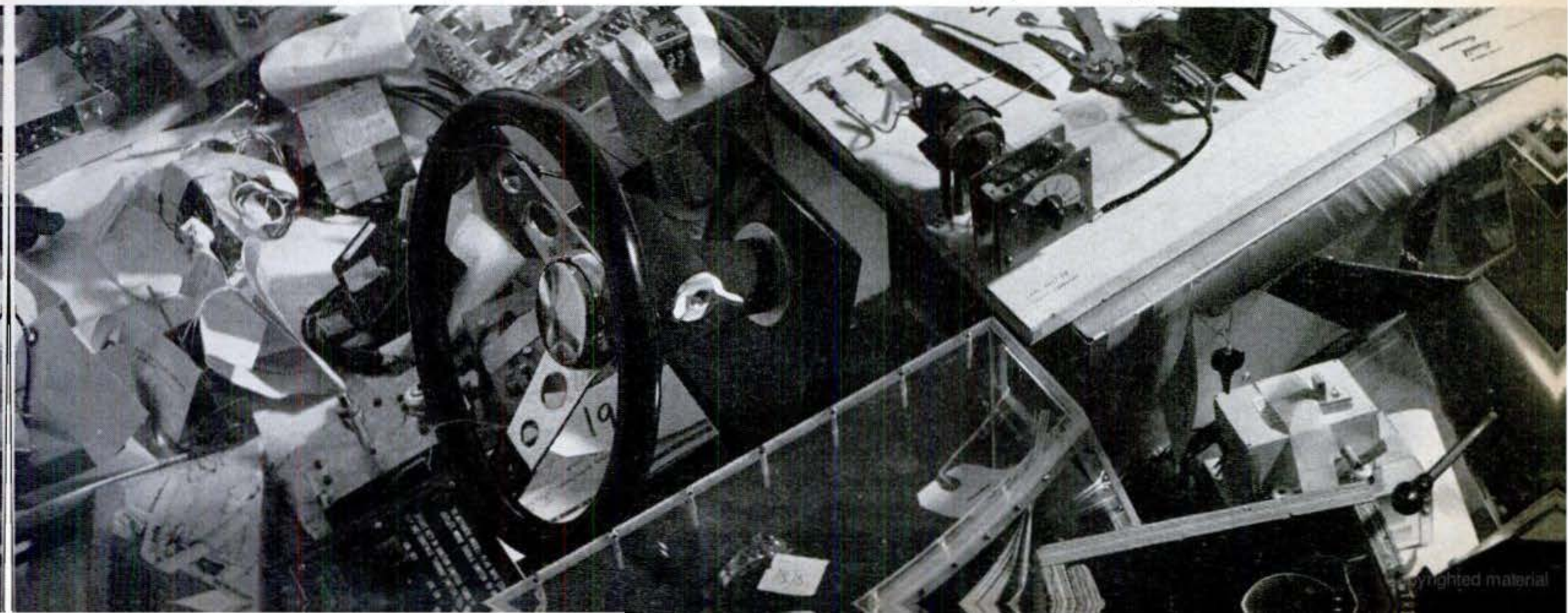
Closet workshop produced . . .



. . . "credit-card" device sparked by

. . . hi-fi electronics hobby.

could be held in the palm of your hand; the largest needed two men to move it. All displayed amazingly fine construction techniques.



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Chrysler's Hydro-Vee hull flies over the Bermuda chop, powered by twin 85-hp outboards. The family boat has family-style safety features such as a full bow rail and a self-bailing motor well.

CARVEL DAY CRUISER: Hot Runabout

A runabout hull with a mini-cabin forward and twin 85-hp outboards at the stern, this Chrysler can ride a trailer—or rough seas

By **JIM ROE** / *PS Boating Editor*

Bobbing at her mooring in the harbor of Hamilton, Bermuda, was the boat I'd come to see and tell you about—Chrysler's Carvel, a 20-foot fiberglass day cruiser. On the transom, twin 85-hp Chrysler outboards were idling and warmed up.

Day cruisers are rapidly gaining in popularity. They vary in length from the mid-teens up to around 26 feet, but all are designed to trail on the highways. Up front is a cabin large enough to sleep a family of four, with room for galley and head facilities. In short, a day cruiser is a perfect design for family-style boating. Despite that, I intended to subject this one to some far-from-family-style treatment so I could tell you about her weaknesses—if any—as well as her assets. As Bermudian Anthony Mello pulled the Carvel up to the dock, I glanced out to sea to size up the rollers.

Soon we were headed down-harbor. There was a strong wind, and as I turned into the deep-water channel the first of many sheets of spray swept over the bow. Water ran down the back of my neck. But you can't know what a boat is like until you give it plenty of rough treatment, so I opened the throttles and hit the chop even faster. I made full-bore turns without trying to avoid the big wave crests. I slammed into the trough—full speed, low speed, dead in the water. I made jackrabbit starts—into the seas, across them, and downwind.

And I got soaked. But the Carvel handled well. She showed no signs of excessive tipping or broaching, no side-slipping. Get caught offshore in bad weather, and the Carvel will get you in safely—and if your family stays below in the cabin, they'll stay dry. During all my rough-neck testing, only a trickle of water seeped into the cabin through the forward hatch.

Satisfied that the day cruiser could handle the seas, I

Day-Cruiser Popularity Keeps Growing

What makes day cruisers so popular with boating families? The hulls—usually 15 to 26 feet long—are small enough to trail on the highways and light enough to launch easily; yet they're big enough to give stability under way and family-style room at anchor or at sea. The cabins provide overnight accommodations for up to four, with plenty of space to store family gear and clothing. Result: You get runabout performance combined with cruiser comfort.

Seafair Sedan is an 18-footer with a stable deep-vee hull. Forward cabin and bunks provide weatherproof living aboard.

Crestliner Viking sleeps two, trailers with ease—outboard or stern-drive powered. The 18-footer will take up to 140 hp.

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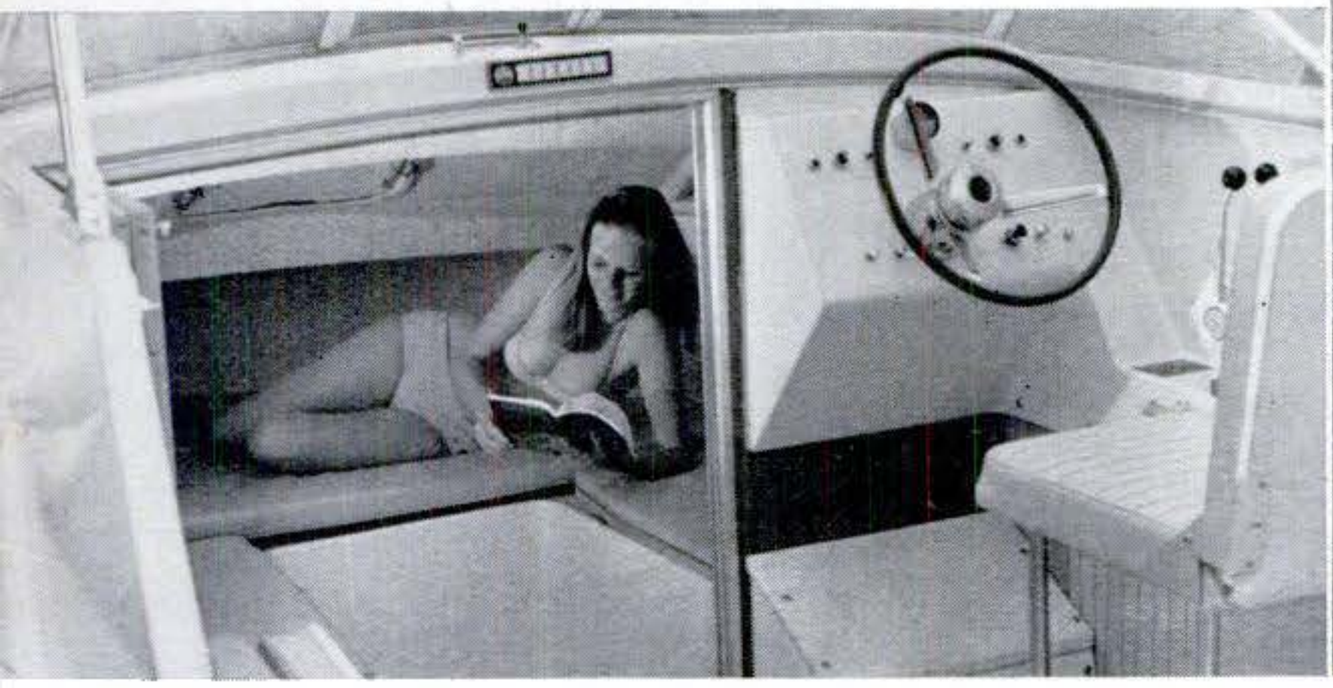
Hydro-Vee hull rides high on water, seen here in head-on view.



Cabin headroom is okay for occupants seated on bunks, but doesn't permit standing. Adjustable helmsman's seat at right slides to the rear and locks there to permit stand-up piloting.

Twin 85-hp Chryslers swinging 13-inch props can make the Carvel fly. The 72-cu.-in. motors have three cylinders, each with its own carburetor. The boat is rated to handle up to 180 horses.

with a "Foc'sle"

headed back to harbor for a more leisurely inspection of the hull, cabin, and cockpit.

The Carvel's cabin has sitting headroom only. Under the two full-length padded bunks, there's plenty of space for gear. You can adjust the two-piece cabin door for either limited or free access between cabin and cockpit.

The helmsman's seat—praise be—is adjustable. And for stand-up driving, it slides to the rear and locks—giving you plenty of foot room between the wheel and seat. A stand-up driver will also appreciate the comfortable cockpit carpeting.

Farther aft is a 30-gallon fuel tank—standard—and a motor well built to the newest BIA recommendations. A solid fiberglass unit, its forward bulkhead is gunwale-high. A following sea could completely fill the well and would run decently back out of the scuppers.

The hull design is Chrysler's Hydro-Vee. Beam is 89 inches; maximum depth, 48 inches. The hull itself weighs a little over 2,000 pounds and can handle a 3,300-pound load in the twin-outboard version, 2,500-pound loads in the inboard/outboard model. The 20-footer is rated to handle twin-outboard combinations up to 180 hp. The two Chryslers on the boat I tested added up to just 10 hp under the maximum and made the Carvel a very lively performer. The I/O version will accept up to 200 hp if you're after the ultimate in performance.

By next morning, the wind had gone down. Overhead, the Bermuda sky was an uninterrupted expanse of blue. It was a perfect day for a complete trip around the island, and for trying the Carvel for the peaceful family cruising she was built to deliver. Bermuda has hundreds of coves to explore, beaches to see, coral heads to examine. So once again I headed the Chrysler out to sea.

Out in the open, maneuvering in and around the coral heads, I found the Carvel easy to handle, at both idle and full speed. I slid the helmsman's seat back and stood, to get maximum visibility as I glided slowly through a maze of coral. Then I headed at full speed into the naval base for a look at the huge concrete seaplane ramps.

Around noon, hunger struck, and I dropped into the cabin for lunch and a respite from the glaring sun. Nice. It reinforced my conviction that the Carvel, and day cruisers generally, are headed for an upsurge in popularity—with families who want some of the comforts of home, and with fishermen who like to go offshore and stay there in stable comfort for hours at a time.

Barbados, 18-footer made by Cruisers, Inc., comes in three versions, including one that converts to floating family camper.

Glastron's Vagabond sleeps four afloat, sets up ashore as a camper-trailer. Transom conceals let-down steps for swimmers.

Cobia's cruiser is powered by twin OMC stern drives. Perched high on flying bridge, you get a good view in all directions.

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10 Quick Checks to Improve

Want to get the most out of your boating trips? Then take a little time to make sure your rig is set up right and that your engine gets proper care. If your motor is new (see below), a good time is at 10-hour checktime.

Your first step is to read the boat- and engine-owner's manuals. Then answer these questions:

- Is my trailer adjusted to support the boat properly?
- What's the condition of the boat's hull?
- Is water trapped in the hull?
- Does the boat need trim tabs?
- Does engine torque make steering rough?
- Does the engine wind up to manufacturer's specifications?
- Have I got the right propeller for my boat and its normal load?
- Is the engine hanging at the right angle to the transom?
- What kind of oil am I using?
- What kind of gas am I using?

Minor concerns, you say. Not really. Any wrong 'un could dampen your boating enjoyment; some could cost you a bundle. All it takes to avoid trouble is some savvy and a little regular attention to your rig. Let's cover each of these points in turn and see what's required to keep an outfit in top condition.

1 Trailer adjustment

Did you know that your boat's performance can be adversely affected by a trailer roller that's out of adjustment? If it's the one just forward of the transom, for example, the keel may bend out of true. A fiberglass hull may be only temporarily damaged; wood and metal hulls can be permanently deformed.

A roller that's too high can put a hook in the keel, causing the bow to ride too low and move from side to side. The more power you apply, the harder the bow dips into the water, causing both engine and boat to slow down. If this condition continues long enough, it can lug the engine down—causing fouled plugs and carboning of the cylinders.

A roller that's too low can cause a rocker to form in the keel, which will result in porpoising and a very rough ride. With this condition, the more power you apply, the harder the bow pitches. Each time the stern lifts, the propeller momentarily loses its grip and the engine over-revs. Eventually, the engine seizes or loud noises indicate serious internal injuries. Engine failure from lugging or overwinding is not covered in your warranty.

2 Hull condition

Take a close look at your hull, from stem to stern. If there's a heavy moss or barnacle growth on any of the planing surfaces, scrape it off. Watch, too, for rough spots, scars, or dents on underwater surfaces. These should be sanded smooth or filled in flush with the hull. Any drag causes loss of performance and engine lugging.

3 Trapped water

Now check your boat's double bottom, if it has one. Drain it if you can —some boats have provision for draining this cavity, others don't. It's not uncommon for a double bottom to hold as much as 50 gallons of water. When you accelerate, all that weight rushes aft, causing the bow to rise and the stern to squat. Result: a slow takeoff that really lugs the power plant in a bad way.

4 Trim tabs

If the hull appears to be in good condition, with no water trapped in it, yet acceleration still seems too sluggish, it's pretty likely that you need a pair of trim tabs or a propeller with a different pitch.

Trim tabs literally push up the after end of the boat and cause it to plane off quicker. The sooner you can get the boat up on plane, the less you will lug the engine. Your local marine dealer can probably help you select the right-size tabs for your boat and tell you how to install and adjust them to get maximum performance for that hull.

5 Rough steering

Does your boat try to go one way or the other when you let go of the steering wheel? The height of the motor on the transom has a lot to do with how the boat steers. If the motor is too low on the transom, propeller torque pulls the stern to one side or the other. If the motor is too high, there isn't enough torque to help you steer.

Rough spots on the boat's planing surfaces can cause hard steering, too. But more important is the angle the engine makes with the transom. You

Tips that will help you keep that new outboard motor in tiptop condition

If you've just bought a new outboard, keep track of the running time on it. You'll want to take advantage of the free 10-hour dealer checkup included in the warranty. It's very important to the future health of your engine.

During the 10-hour check, many symptoms of future problems can be detected. Ten hours usually gets you past the break-in period. Your engine may be running a little rough and simple adjustments of the carburetor(s) should smooth it out. It's also a good time to look for loose nuts and bolts, displaced wiring, and moving parts that have vibrated out of adjustment.

By now, too, you're familiar with your engine's peculiarities. It's a good time to ask questions. But make them specific rather than general—most dealers are too busy to get into the hypothetical.

After the 10-hour check is over, it's up to you to carry out routine preventive maintenance. This includes such things as keeping the propeller trued up, the lower-unit skeg straight, the inside of the lower unit properly lubricated, and the propeller-shaft seals intact and free of stray lengths of fishing line.

You should inspect the lower unit regularly to be sure that no water has leaked in—water damage to the lower unit is *not* covered by the warranty. The owner's manual tells how to get a look into the lower unit and how much oil it needs to operate properly. It also tells where and how often to apply grease there.

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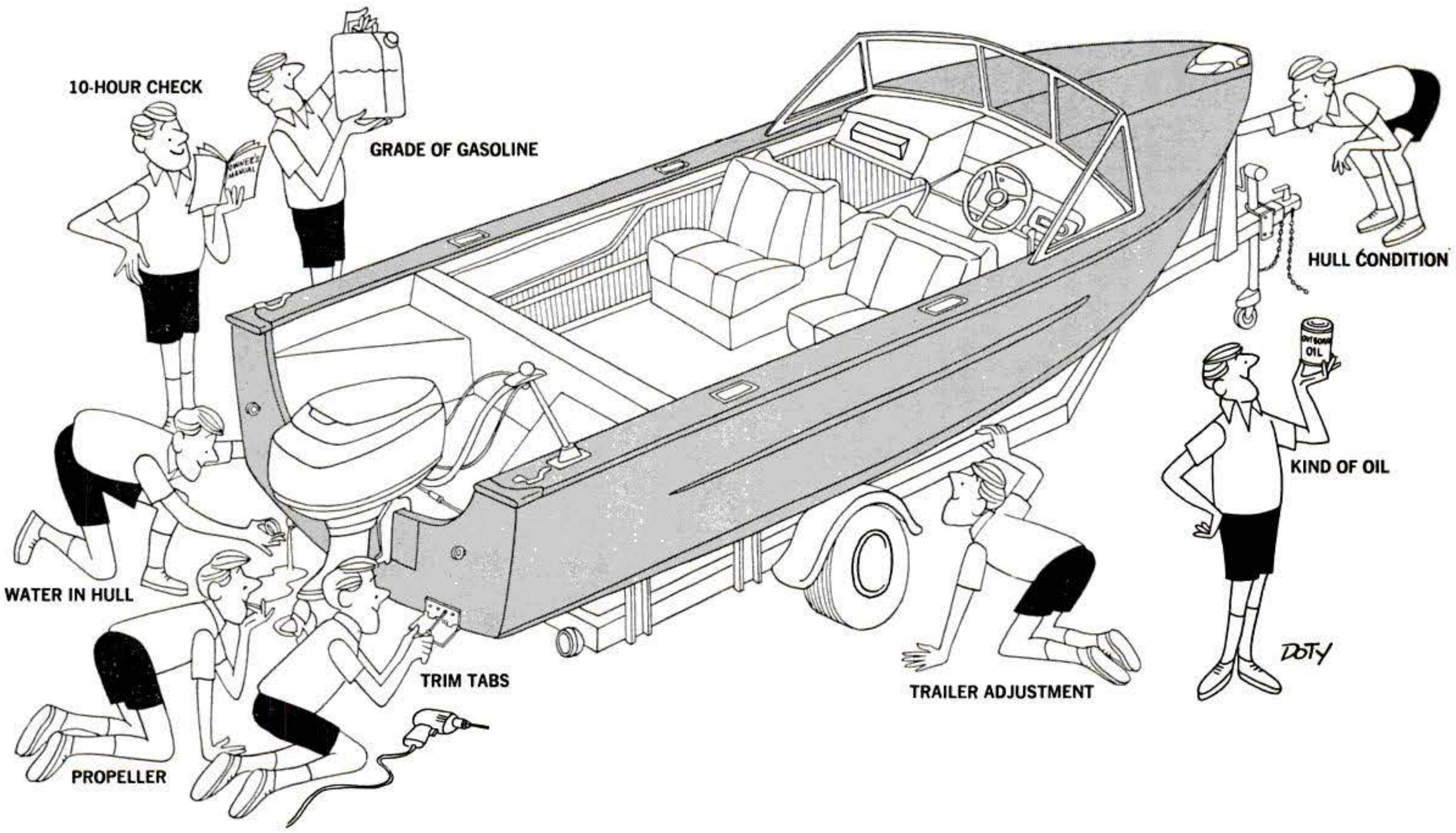
Your Boat's Performance

By LARRY M. PIERCE
ILLUSTRATION BY ROY DOTY



should vary the engine's trim adjustment until you find the setting that makes the boat ride most nearly level and steer easily.

6 Engine revs

Let's assume that you've conquered all the hull problems. *Now* does the engine wind up to specifications? It should operate within the rpm range recommended in your owner's manual or it will eventually suffer serious damage.

An engine tune-up—carburetor cleaning and adjustment, fresh spark plugs and points, and the like—may bring the revs up to snuff. If it doesn't, you probably have the wrong propeller for your boat.

7 Propeller

Nine times out of 10, the standard propeller on a new engine does not match the boat it's clamped to. That's because each boat and the load it normally carries is different. You won't find the answer in a book; you will have to try various props until you find one that turns at the right rpm to suit your rig.

8 Engine tilt

Engine tilt comes in here again. For all-out performance, kick the motor out as far as you can without causing the boat to porpoise or the propeller to lose its grip. For most cruising, the general rule of thumb is to tilt the engine until the propeller shaft is parallel to the bottom of the boat when it's underway at planing speed.

Remember, of course, that when you change the load in your boat (or move it around significantly) you should change engine tilt to match the new weight distribution.

9 Kind of oil

Is the oil you're mixing with your gasoline good enough; are you using enough of it? You don't necessarily have to use the manufacturer's oil, though it's a good idea. But by all means stick strictly to two-cycle, 30-weight oil, and mix it with the gas in the proportions advised by your owner's manual.

If you use an oil other than the one recommended by the manufacturer, always use more of it per gallon of gas, as a safety measure. Don't go to extremes, naturally. Too much oil fouls the plugs and carbons up the engine, causing rough idling and sluggish acceleration. Too little oil causes piston seizures and engine failure. Thorough mixing of oil and gas —by shaking them together in a portable container before filling the tank —improves your chances of trouble-free boating. Thoroughly mixing the oil prevents it from settling out and clogging the carburetor.

10 Kind of gasoline

Finally, let's talk about gasoline. Don't buy gas with the oil already mixed in, if it's sold in your area. The mixtures are seldom correct for your engine. Use only a good brand of regular-grade gasoline or marine gas. Contrary to what many believe, high-octane gasoline does not make an outboard run better consistently. Instead, it coats pistons and rings with the lead additive and shortens ring life considerably.

Of course, there's the opposite extreme—using too low a grade of gasoline. This has the same effect as adding too much oil and will cause your engine to carbon up.

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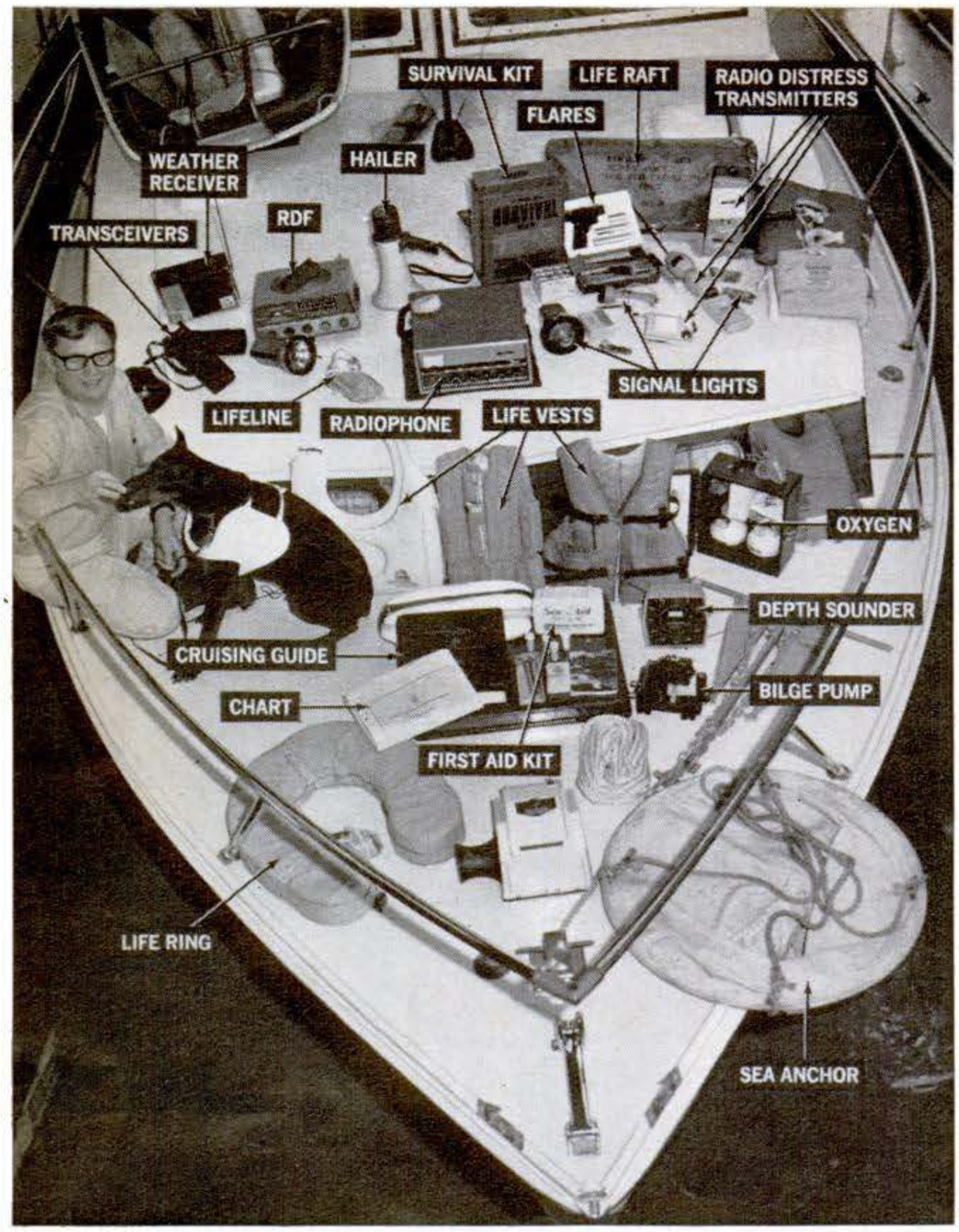

Distress gear crowds the foredeck of author's Roe Boat. Some of the items: **Life vests**—Texas Water Crafter dog vest, $8; Winslow inflatable Mae West, $25; Gentex Escort, $30. **Radio distress transmitters**—Mayday transceiver, $150; ACR RT 60B pocket transceiver, $560; radio locator beacon, $185. **Signal lights**—ACR strobe lights, $30 and $35; distress marker light, $58; ACR water-activated flashlight, $16. **Life ring**—West horseshoe collar, $26.

Flashing strobes, like this pocketable DuKane Safety-Lite for $23, are among the newest kinds of distress signals. It will flash from four to five hours nonstop.

New Devices That Help When Your Boat's in Distress

By **JIM ROE** / *PS Boating Editor*

A stout mooring line is probably a boatman's single most important safety item—but not as you usually think of it. Sure, it should secure your boat under every conceivable natural stress, but even more important in avoiding most boating emergencies is the good judgment on when to cast off and when not to.

The truth is, most trouble on water is caused by venturing out in weather beyond the capabilities of either the boat or its operator, exceeding the boat's load capacity, failure to have enough fuel aboard, or reckless driving.

Here's a sampling of the latest emergency devices to keep you out of trouble in the first place, or help you cope with common distress situations. Let's hope you never need them.

Signal kits include flare gun with shells, orange distress flag (rolled up), smoke makers, dye markers—all by Olin. Throwing ring by West has a strobe light, whistle attached. Large light is ACR's floating distress marker (range, 15 miles). Roe holds Mayday II distress transceiver (above, left) and ACR pocket-size UHF-VHF tone transmitter for rescuers to home in on.

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Multiband automatic RDF ($250) next to Roe receives aircraft weathercasts, too. Also visible: chart, port pilot, logbook, Zenith weather command radio, Raytheon depth sounder ($100), Peters & Russell bilge pump ($15), Winslow safety harness.

135-watt radiophone (lower left) is one of the most useful devices. Winslow survival kit ($44) has food, water, fishing gear, signaling gear. Pulling a lanyard releases bottled gas that inflates the eight-man Winslow life raft ($450).

Take family's prescription drugs, Roe advises, along with a marine first-aid kit. Mada Medical's oxygen pack: $80.

Motor mount on Kelley's white-and-blue Sportin' Jenny handles outboards up to 3.6 hp

Kelley's One-Piece Plastic Boat

A young, independent engineer named David Kelley molds one-piece plastic boats in a vacuum frame he built himself. Kelley believes he's one of the first to lick all the problems of making a rigid, tough, lightweight plastic boat for a reasonable price.

Sportin' Jenny—as Kelley calls his craft—is eight feet long and 45 inches wide, weighs 56 pounds, retails for $149. Made of ABS plastic, the "unsinkable" double-hulled boat has row locks and a motor mount.

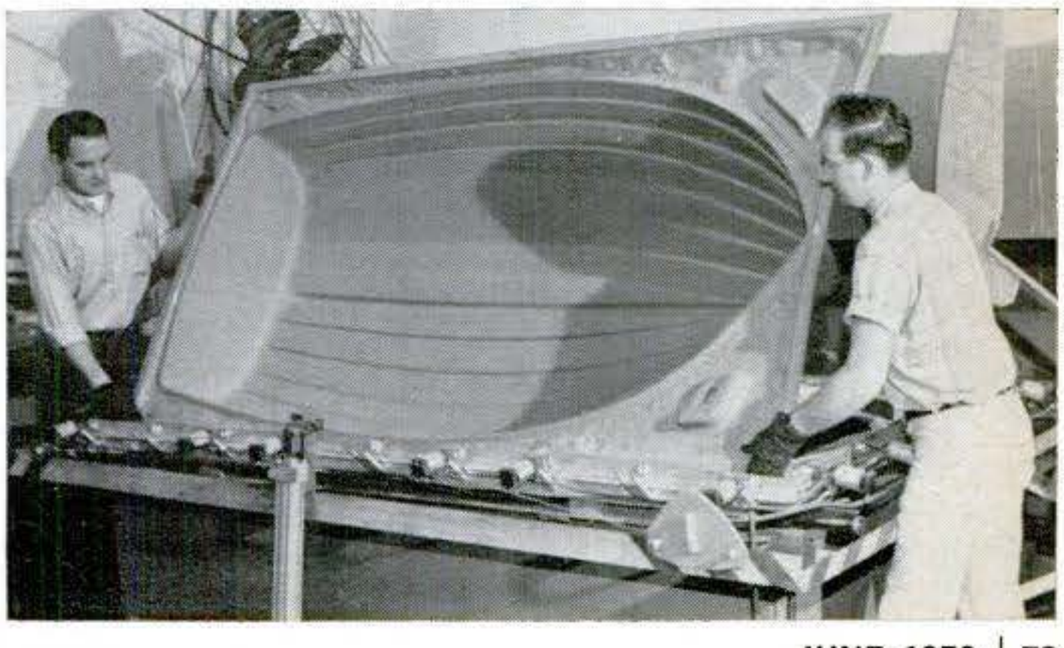
"You can't dent it," says Kelley as he swings a sledge hammer at the boat. "One blew off the top of a man's car on the freeway the other day and it was only scuffed up."

He molds an inner and an outer hull, saws off the excess plastic, and staples the two hulls together. He seals the stapled edges with a rubber bumper strip and bolts on a plastic motor mount. There's no painting—the color is molded into the plastic.

Kelley says his process can be adapted to any open shape. The only limit is the width of ABS plastic manufacturers supply. The Novelty, Ohio, engineer built his own equipment: a movable welded frame, heating unit, vacuum hookup, and electronic control panel—*R.S. Fairchild*

Eight-foot plastic dinghy weighs only 56 pounds, despite double-hull construction.

It took four minutes to form this hull. Both sides of ¼-in. ABS plastic sheet were heated at 350 degrees to taffy-like softness and dropped into a mold. Vacuum pump, hooked up to 1,500 tiny holes in mold, sucked plastic into shape.



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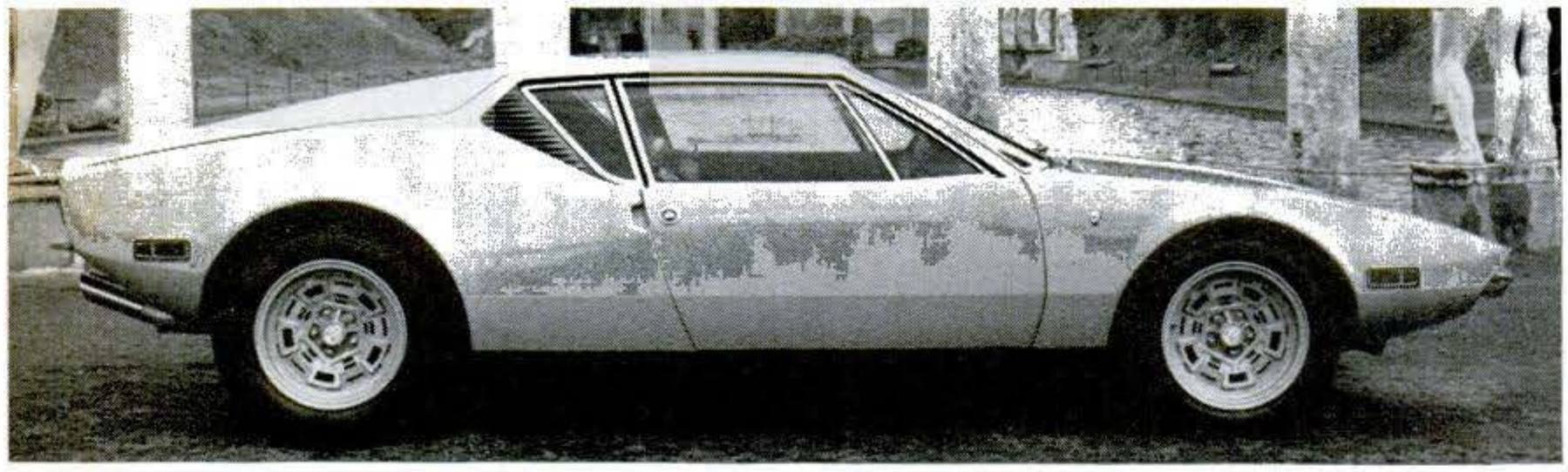
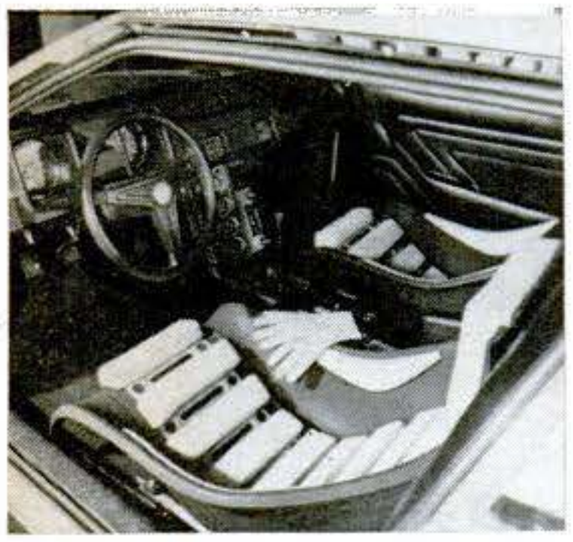
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



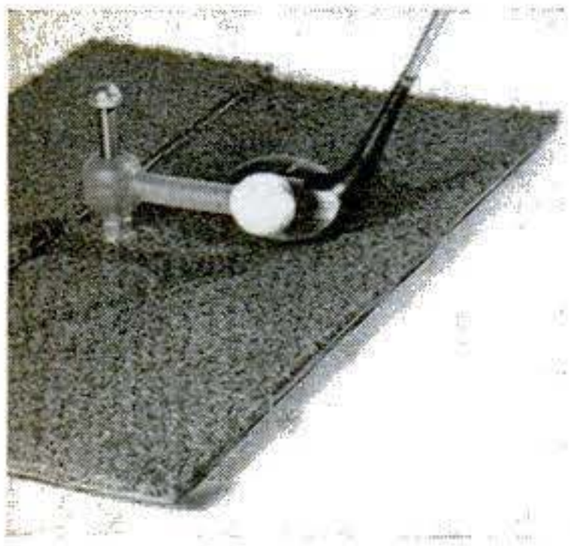


▲ Italian Panther—it'll be stalking the Corvette

Pantera—Italian for "panther"—they call this sleek job, produced by de Tomaso Automobili, designed and built by Ghia of Turin, and to be sold in the U.S. by Lincoln-Mercury dealers. Ford's 351-cu.-in. Cleveland engine—amidships in the all-steel unit body—has been modified by de Tomaso to put out 310 hp at 5,400 rpm. Strictly a two-seater (aluminum-shell bucket seats with polyurethane pads, left), the car is intended to compete with Chevrolet's Corvette. Price: rumored around $8,400—about 15 percent higher than a well-equipped 'Vette.

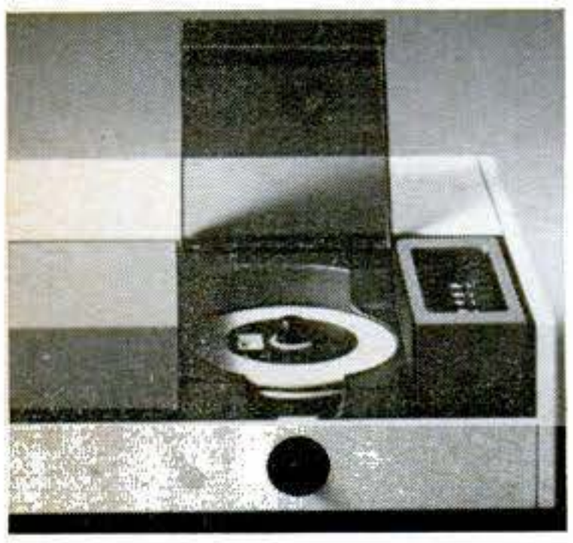
Bye-bye bookie ▲

It's self-service at a Paris track. Put a 10-franc note in a machine, push a win, place, or show button, and another numbered to match your horse. Out pops your ticket. Or, as with any vending machine, it could keep your money and give you nothing—but that's gambling.



◄ Duffer's special

All the power of a Jack Nicklaus swing couldn't drive the golf ball off the Wacker. It's fixed to a rotating arm. And since it doesn't go anywhere there's no need to look up and follow its flight—you learn to keep your head down. It's $19.95 from Wacker Co., 730 Emerson Rd., St. Louis, Mo. 63141.

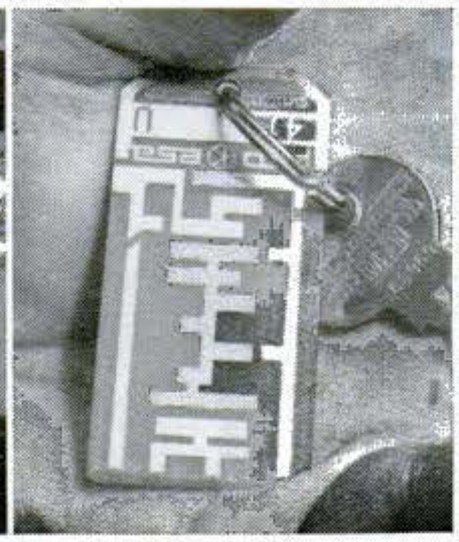


◄ Home televiser

It's actually a miniature TV station. It plays color—or black-and-white—film cartridges through your color—or black-and-white—TV. It's the Teleplayer. Motorola and CBS developed it for business and educational use, but intend, eventually, to put one in your home. It will be out in September for $795.

Your caller in color ▲

"Hell-o dear. I just called to see how you like my new hair color." Toshiba didn't design their new color TV-telephone for that kind of conversation, but it's more fun than the corporate talk they had in mind. If you want to see the TV-phone in action, drop into the Toshiba Pavilion at Japan's Expo '70.



Electric credit card ►

A printed-circuit credit card is the key to self-service gasoline in England. The gas pump unlocks when you insert your card in a slot to fill your tank. A data recorder recognizes your card, records your number and purchase on tape, and bills you later. The tiny circuit board doubles as a distinctive key fob.

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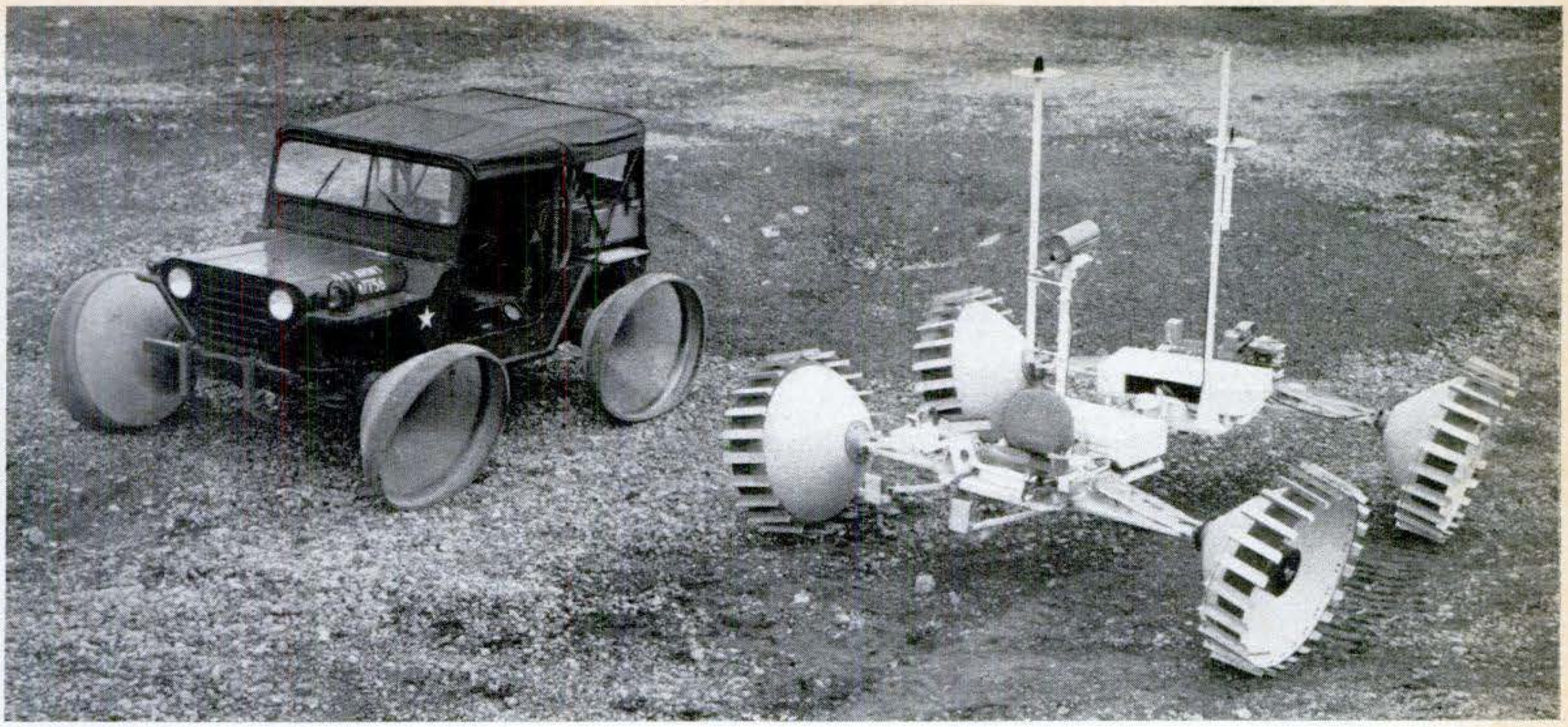


▲ Down-to-earth use for moon wheels

You may never get a chance to drive Grumman's lunar rover vehicle on the moon, but you could end up driving a jeep equipped with the rover's wheels here on earth. Tests of the Markow wheel, say Grumman engineers, indicate that it has great potential for adaptation to all kinds of off-road vehicles. It's safe, reliable, smooth-riding. Now Grumman is looking over designs for everything from golf carts to snowmobiles. One application might be on a remote-control rig, similar to the lunar rover, for patrolling pipelines in the new Arctic oil fields.

Electronic newsboy ▲

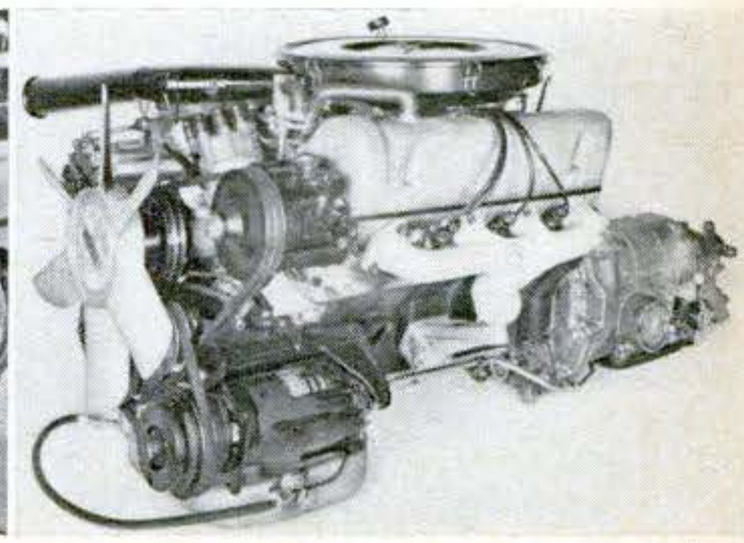
Is this how you'll get your newspaper in the future? Maybe, says Toshiba, the Japanese electronics firm that developed this facsimile receiver. It prints both sides of a sheet simultaneously, in six minutes. If mass-produced, the device would sell for an estimated $300.

◄ Foam home

Spray plastic foam between aluminum and hardboard skins, and you have a complete wall for a house: outside, inside, and insulation. That's how Kaiser Chemicals built this section for a prototype house constructed without a nail or a scrap of wood.

Gothic V8 ►

There's a brand-new overhead-camshaft fuel-injection V8 in the newest Mercedes-Benz luxury cars. It's rated at 230 hp, takes the sedan up to 120 mph. The car has four-wheel disk brakes and Mercedes-Benz's own automatic transmission. Full power equipment is standard. Price: $12,000.



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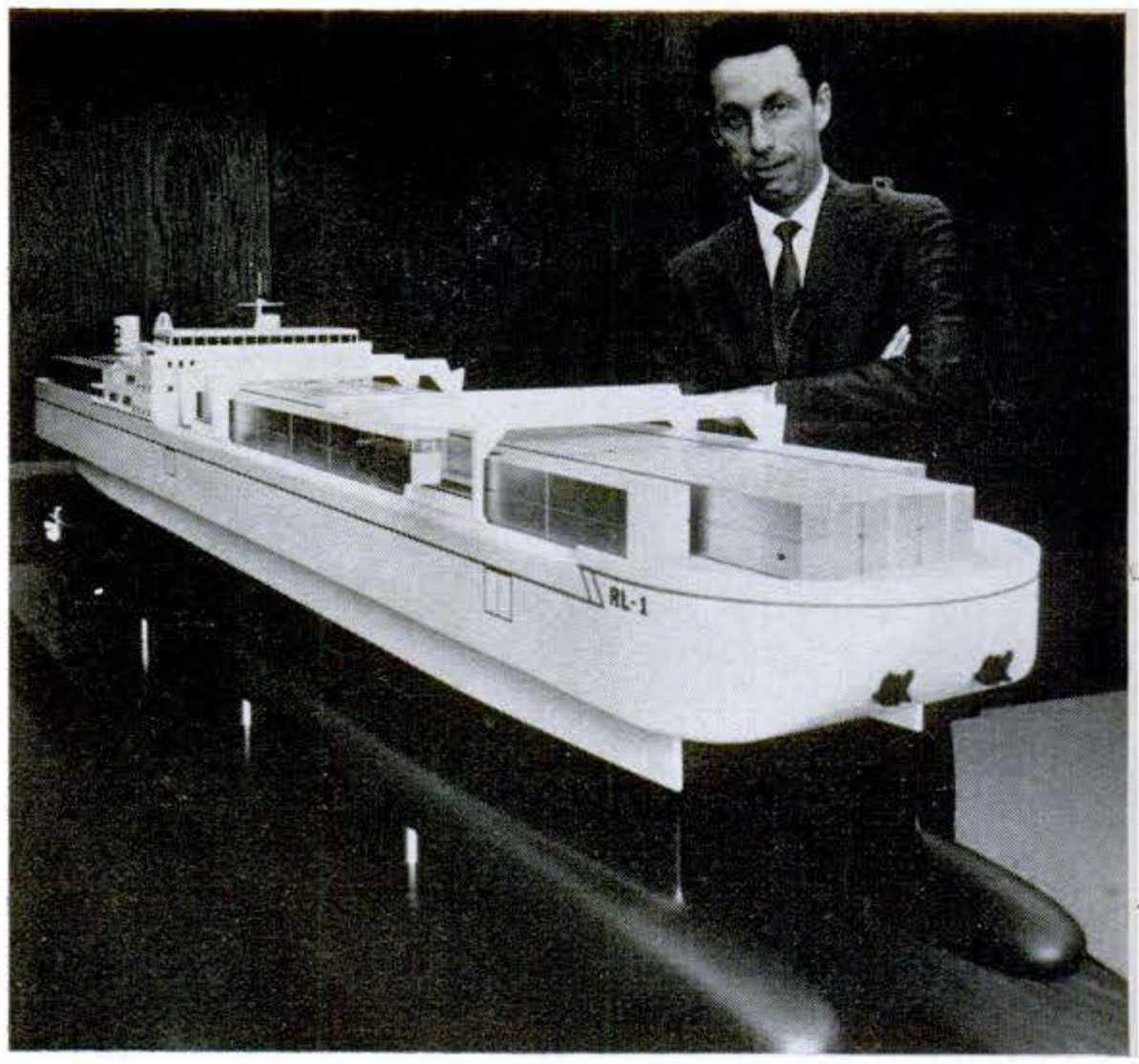
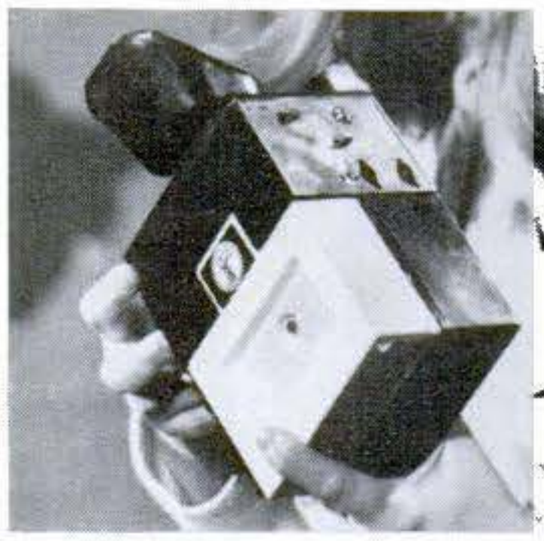
What's New

New ship shape ➤
A revolutionary new design—a hull that rides on two submerged pontoons—could give ships as large as aircraft carriers a top speed of 50 knots. The Trisec design, being developed by Litton Industries, also improves stability. It could be adapted to surface vessels.



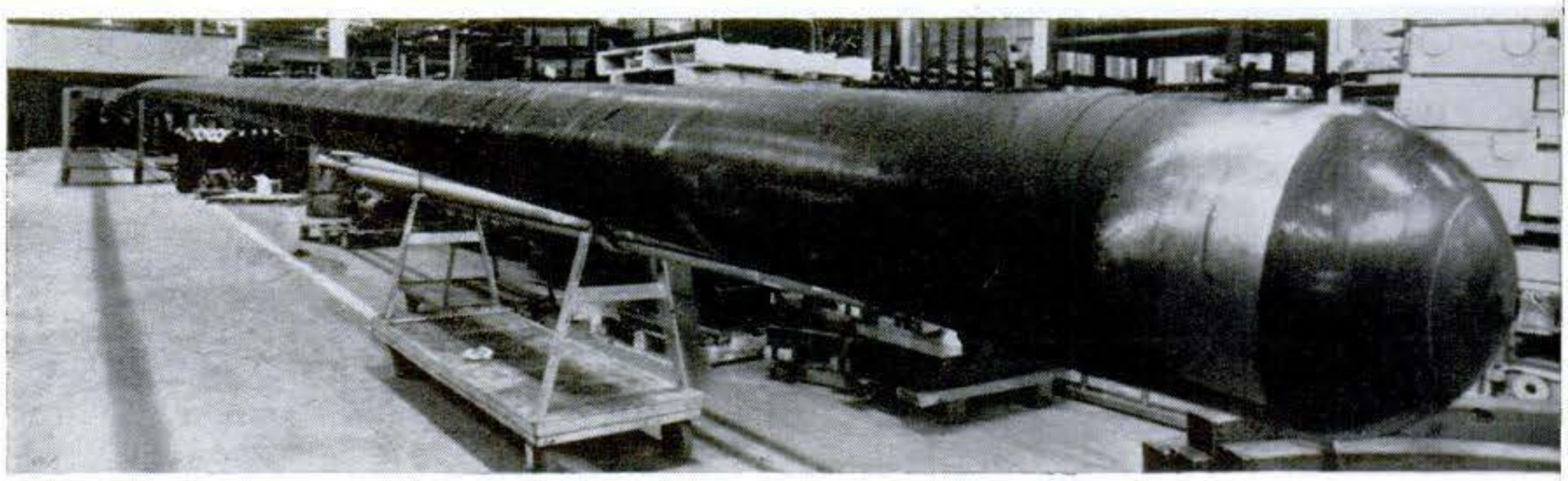
← Blow-ups
Try on one of these inflatable plastic suits for size, if you work with insecticides or other toxic chemicals. A 200-foot hose circulates cool air through the suit, providing insulation from heat as well as protection from the fumes. It's made by Martindale Electric, Neasden Lane, London.



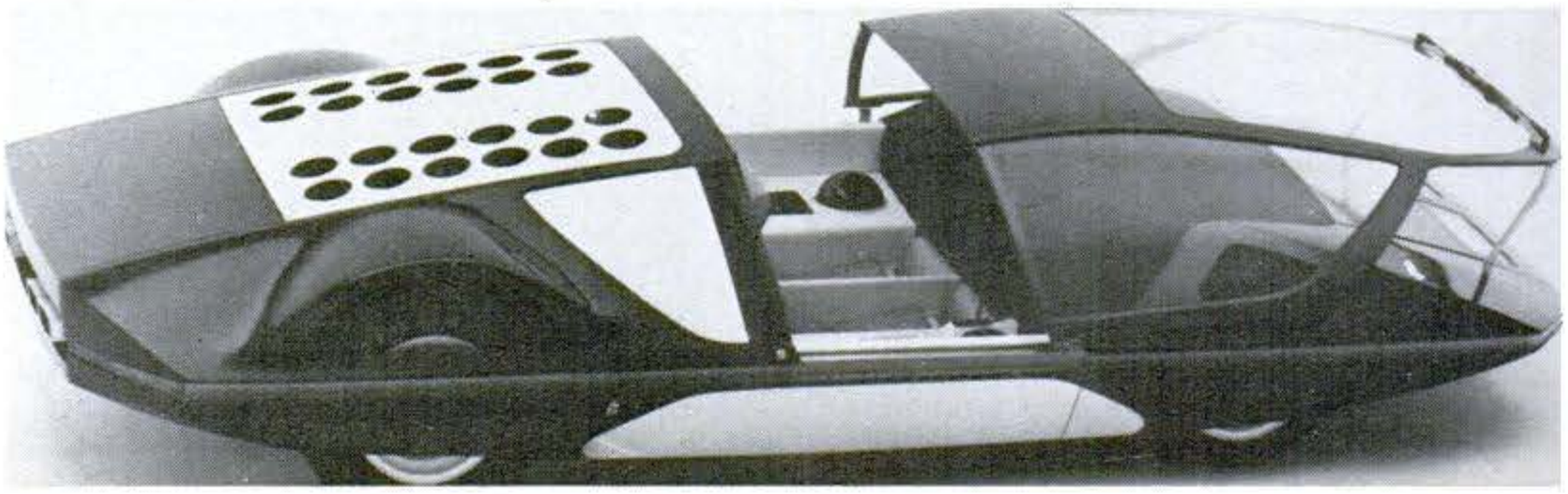
← Italian AMX/3
Ford isn't the only Detroit auto maker building cars in Italy these days. Look what American Motors has just introduced: the Italian-designed and built midships-engined, two-seat AMX/3. Power from AM's biggest V8 (390 cubic inches) is combined with a new all-synchro transaxle.

Palm-size theater ↑
Hold this projector up to your eyes, slip on the earphones, and flick a switch—you get four minutes of sound movies from an 8mm snap-in cartridge. The Rheem 4600 is designed for personnel training and home study. Price: $89.95. Rheem Mfg., 400 Park Ave., New York, N.Y.

Super-sausage ➤
That giant sausage at right is actually a 56-foot lance tube for a soot blower. Still in the dark? Okay, the TVA is using 36 soot blowers to clean out a giant 1,300-megawatt pressure boiler. The blowers force high-pressure steam or air through the tubes, pushing out dirt and restoring boiler efficiency.



Modular auto body➔
This way-out design exercise by Pininfarina uses modular construction, with basic sheet-metal assemblies that can be combined to give a number of different body types. Named the Modulo, it's built on a Ferrari 512 S chassis, and is powered by a 550-hp fuel-injection V12. Swiss-cheese panel covers the engine.



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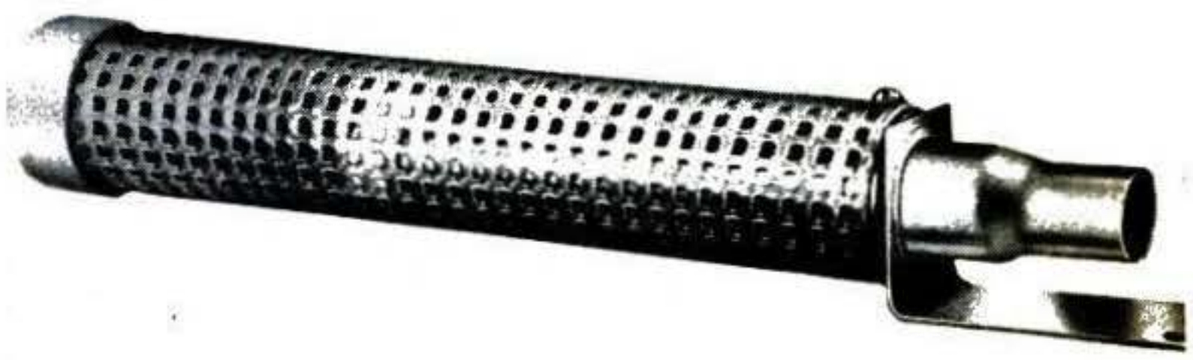
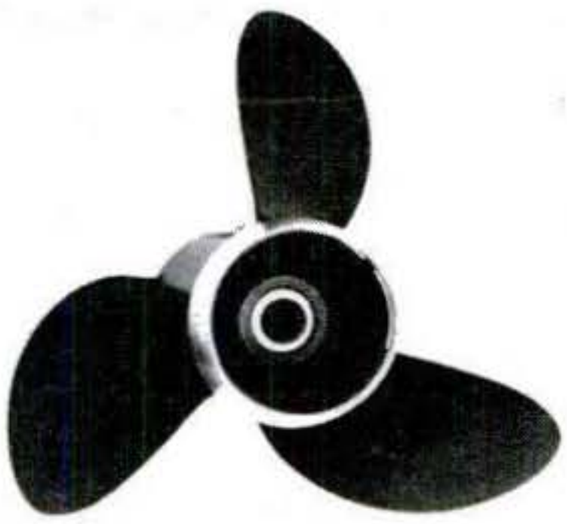
What's New
IN BOATING

Two-way traveler ➔
It's a boat at sea, a camper (on a special trailer) on the road. Combo-Cruiser comes complete with fridge, stove, shower, water heater, toilet, and sleeping space for six. Top speed on water is 20 mph. It's vacuum-formed from two huge sheets of ABS plastic—if dented, it reshapes automatically with heat.

Good to the last drop ➔
Bilge pump always clogging? This new strainer could solve your problem. The compact brass and plastic device fits in the lowest part of any hull, including deep-Vees, to remove bilge water down to the last drop. It's $5 from Peters and Russell, 550 W. Liberty St., Springfield, Ohio 45501.



← Fiberglass fish
A unique British design is beginning to make waves in the car-top sailboat fleet. The Bonito has an aluminum mast with a flexible fiberglass top section, a battenless Dacron sail, and an open cockpit with no transom—spray drains right out the back. It's made in the U.S. by Lincoln Fiberglass, Route 62, Stow, Mass. 01775.



↑ Slick propeller
A Teflon coating on Johnson's new stainless-steel propeller decreases drag in the water, giving you as much as three mph higher speed and better gas mileage, too. It also resists corrosion. The new prop is priced at $79.50.

← Car-topper's companion
No sweat getting a boat up into travel position—if you take Aluma Craft's new loading device on your next camping trip. The Alone Boat Loader makes it an easy one-man—or woman—job to load even a good-size boat like this 14-footer atop your car or pickup camper.

Breeze meter ↑
Big wind coming up? You can measure it with this Sims BT anemometer. Hold it in any breeze and read the wind speed directly off the scale—in mph or knots. Dual-level scale reads up to 70 mph. Accuracy's within two percent, says the maker, R. A. Simerl, 238 West St., Annapolis, Md. Price? $39.50.

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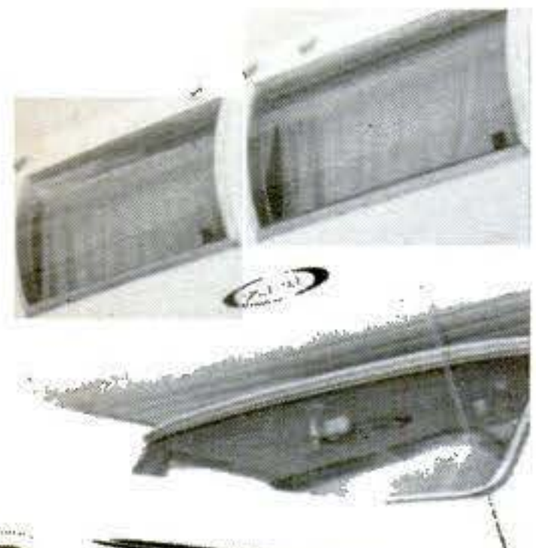
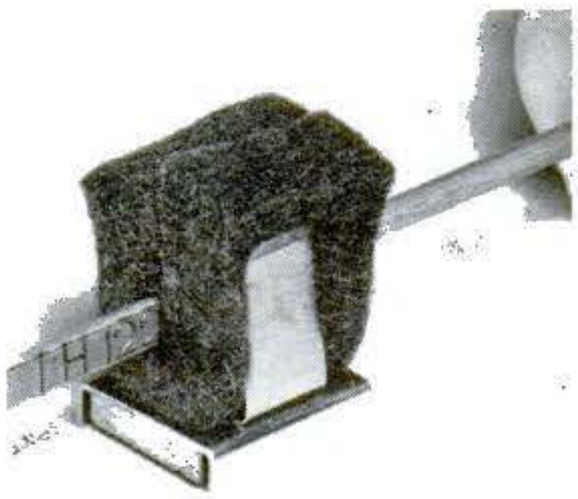
What's New
FOR YOUR CAR

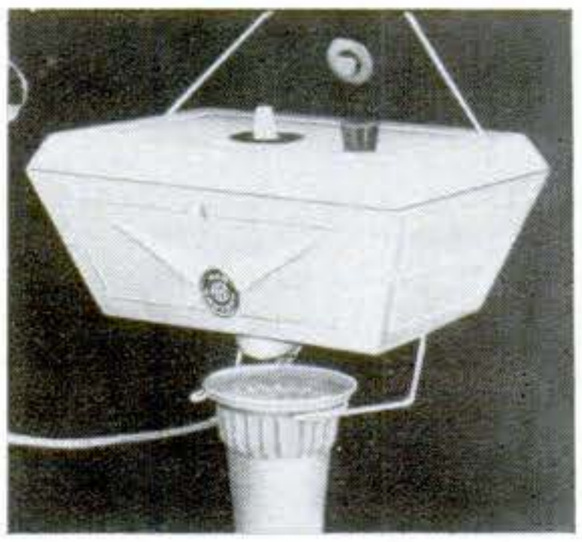
Electrical tester ➤
You can test all electrical circuits in a car simultaneously with the portable Autoscan 560 without disconnecting the battery. Five test modes give quick readings on state of battery charge, ability to take charge, alternator output, diode efficiency, starting capability. Autoscan Inc., 3641 Holdredge Ave., Los Angeles 90016.





Dipstick wiper ▲
This absorbent-felt magnetic-base dipstick wiper stays put, lasts indefinitely. It's $1 from H. C. Sterten, Box 45652, Los Angeles 90045.

◄ Tough truck tire
High performance goes with Firestone's wide-oval nylon tire for campers. Sizes: 8:00-16.5, 8.75-16.5, 9.50-16.5.



▲ Coffee on the go
A rolling kitchen—that's what your car becomes with Car Canteen. Plug into lighter socket, and in minutes you have hot tea, coffee, cocoa, or soup. To fill cup, suspended below tank, just press a button. Capacity: six cups. $12.95 from H. C. Short, 1104 Gary St., Monahans, Tex. 79756.

▲ Toe-in checker
A flag in the side of the Tred Saver shows the condition of your front-end alignment when you drive one front wheel over it. The simple check helps you avoid running with excessive toe-in or toe-out (which can cause instability and tire wear). Under $15 from Polytechniques, 17100 Miles Ave., Cleveland 44128.

▲ Emission-control kit for older-model cars
Here's an antipollution package by General Motors for 1955-65 model cars. On tests of 101 cars fitted with the kit, hydrocarbon emissions sank 52 percent; carbon monoxide, 37; nitrogen oxides, 31. A thermo-vacuum switch (top left) checks overheating when the spark is retarded and the car is in slow traffic. If coolant temperature reaches 205 degrees, the switch, mounted in the top radiator hose, activates the vacuum spark advance. Vacuum hose (lower right) connects switch with engine distributor and manifold vacuum. California's Air Resources Board is considering the kit for certification.

What's New
IN TOOLS

Safety shield ➤
For workshoppers who find goggles uncomfortable and won't fuss with them—even while doing grinding or lathe work—here's a low-cost, lightweight face shield that offers total protection. Interchangeable visors of the Protecto-Shield come in various colors and lengths. Willson Products, Box 622, Reading, Pa. 19603.

Pocket-clip engraver ▲
Nothing's too hard for this diamond-point marking pencil. You can engrave your name and address on tools, guns, cameras, jewelry, and keys as easily as you'd write with a pen. Or scribe designs on glass, metal, and ceramics. It's $7.95 (with extra diamond point) from Rolyn Optics, 300 Rolyn Place, Arcadia, Calif. 91006.

Instant angle readings ▲
Sensitive to half a degree, this automatic protractor provides accurate readings from 0 to 90—and is a gravitational level, too. Angles relative to horizontal or vertical planes can be read at once; to check roof or stairway pitch, you use a conversion chart on the back. Under $5 at most Sears Stores.

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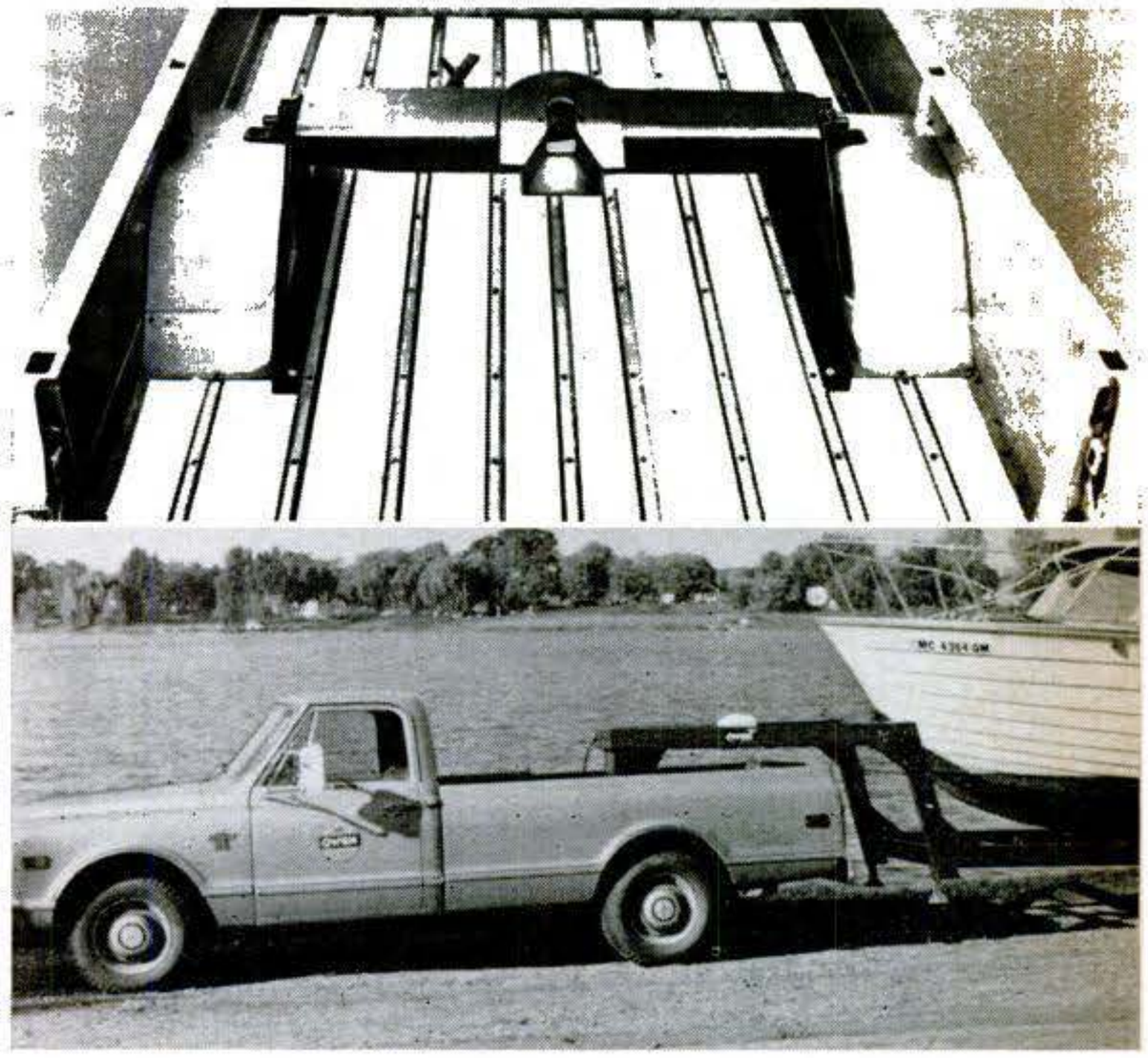
What's New
IN OUTDOOR RECREATION

Hose-powered outboard ➤
Attach a garden hose to the Pool Shark jet outboard, and you zip around the pool with a jet-like sound and even a rooster tail. The fun outboard is made of polystyrene, propels two kids or one adult in a play boat. Price: about $15. Maker is Johnny J's Enterprises, 36855 Schoolcraft, Livonia, Mich.

▲ Mini probe light
The heart of this inspection kit for machinists is a tiny light at the tip of a probe you can insert into cavities and even pass around corners. The No. 10 kit includes penlight shell, alkaline batteries, three probes (rigid and flexible) and mirror. It's $24.95 from Starlight Corp., Mountain Home, N.C.

▲ Fisherman's glove
Like to catch 'em but hate to clean 'em? Slip on a Gaff-mitt. It protects your hands from sharp scales, while plastic spurs give a secure grip. Large, medium, or small; $3.75 from Anderson's, 2200 Ridge Rd. W., Rochester, N.Y. 14626.



Easy rider ▲
You can install the Classic Hitch in 30 minutes, says its maker. Designed for towing heavy loads behind a pickup, it has a drawbar capacity of eight tons. Locking pins let you remove the crossbar (upper photo) and use the truck bed for light hauling. Classic Mfg., Box 369, Sturgis, Mich. 49091.

▲ Paint writer
Squeeze—and this paint-filled plastic bottle with a steel ball tip lets you permanently mark any surface. Great for identifying metal castings, lumber, glass, cardboard cartons. The markers come in 13 colors at $1.56 each. Not available locally? Write Markal Co., 250 N. Washtenaw Ave., Chicago 60612.

▲ Big stretch
Fasten anything with this rubber tie-down strap. Two S-shaped hooks can be attached at different points on the straps to permit varying tension. Straps extend from 18 to 36 inches. Not enough? Hook two or more together. They're 89 cents. Tempo Products, 6200 Cochran Rd., Cleveland, Ohio 44139.

Blow-up tent ➤
You don't need poles, stakes, or ropes with the Inflat-a-tent. It goes up in seconds, supported by its own air ribs. It's bright international orange, sells for $9.95 from Illi Enterprises, Box 2133, Ann Arbor, Mich. 48106.

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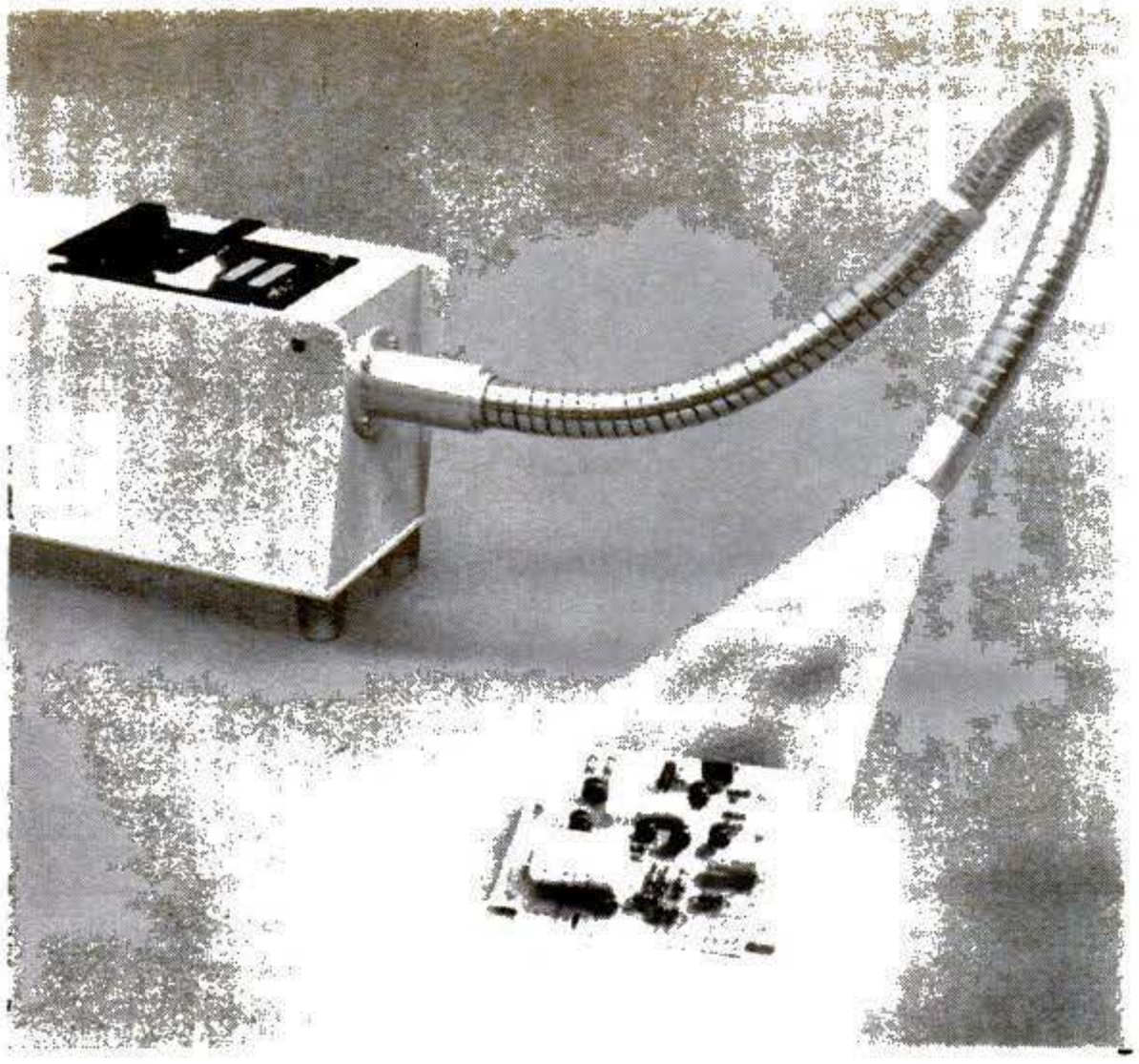
What's New
IN ELECTRONICS

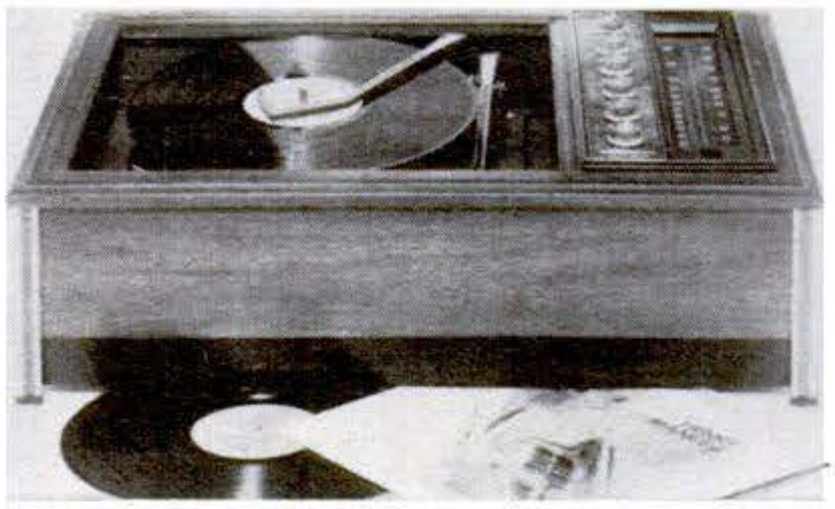
Swivel set
RCA's new "Exquisite" is a 15-pound personal portable TV on a sculptured swivel base. It's easily carried from room to room—even follows you out to the patio, where a tinted plastic screen filters out sunlight to boost picture contrast. Price? About $110.

Two-way chest radio
It's not quite as compact as Dick Tracey's wrist radio, but this two-way FM radio being developed by Hallicrafters for policemen does strap to the body—across the chest like a shoulder holster. It can be worn inconspicuously under clothing, leaving the user's hands free while he communicates with police headquarters.



A light pipe to brighten your work
To throw light into those hard-to-see areas of electronic circuits you might try a fiber-optics illuminator. This one, by Bausch & Lomb, pipes an intense spot of light from a fan-cooled quartz-iodide lamp into the darkest corner of your electronics project. It's like having a light in the end of your finger. The light-source box operates on standard household current and comes with a choice of two- or three-foot fiber probes encased in flexible stainless steel. It's $300 from Bausch & Lomb, 635 St. Paul St., Rochester, N.Y.

Sound in the round
Omni-directional, air-suspension speakers; AM/FM tuner; four-speed turntable with a tone arm that tracks at 1/10 ounce; 20-watt solid-state stereo amplifier—that's what you get in the new Magnavox Astrosonic sound system. The modular unit comes in walnut with metal trim for $279.



Magic lamp
This ceramic replica of an old oil lamp won't put out any light, but it will give you a TV picture. A disguised TV antenna, it's designed to replace unsightly rabbit ears. $12.95. Vorta Systems, P.O. Box 613, Round Lake, Ill. 60073, makes it.

Ultrasonic switch
From your easy chair you point the tiny transmitter (above, left) at the receiver (right). Push the button and ultrasonic waves trigger the receiver to turn on or off any appliance plugged into it. Great for controlling TV and radio. Knight-Kit KG-203 is $16.95. Allied Radio, 100 N. Western Ave., Chicago 60680.

Big sound
Westinghouse claims you'll get maxi sound from this new mini radio. The solid-state one-pounder has a square, top-mounted speaker, thumb-wheel tuning, and automatic volume control. Earphone and jack are included in the $10.95 price.

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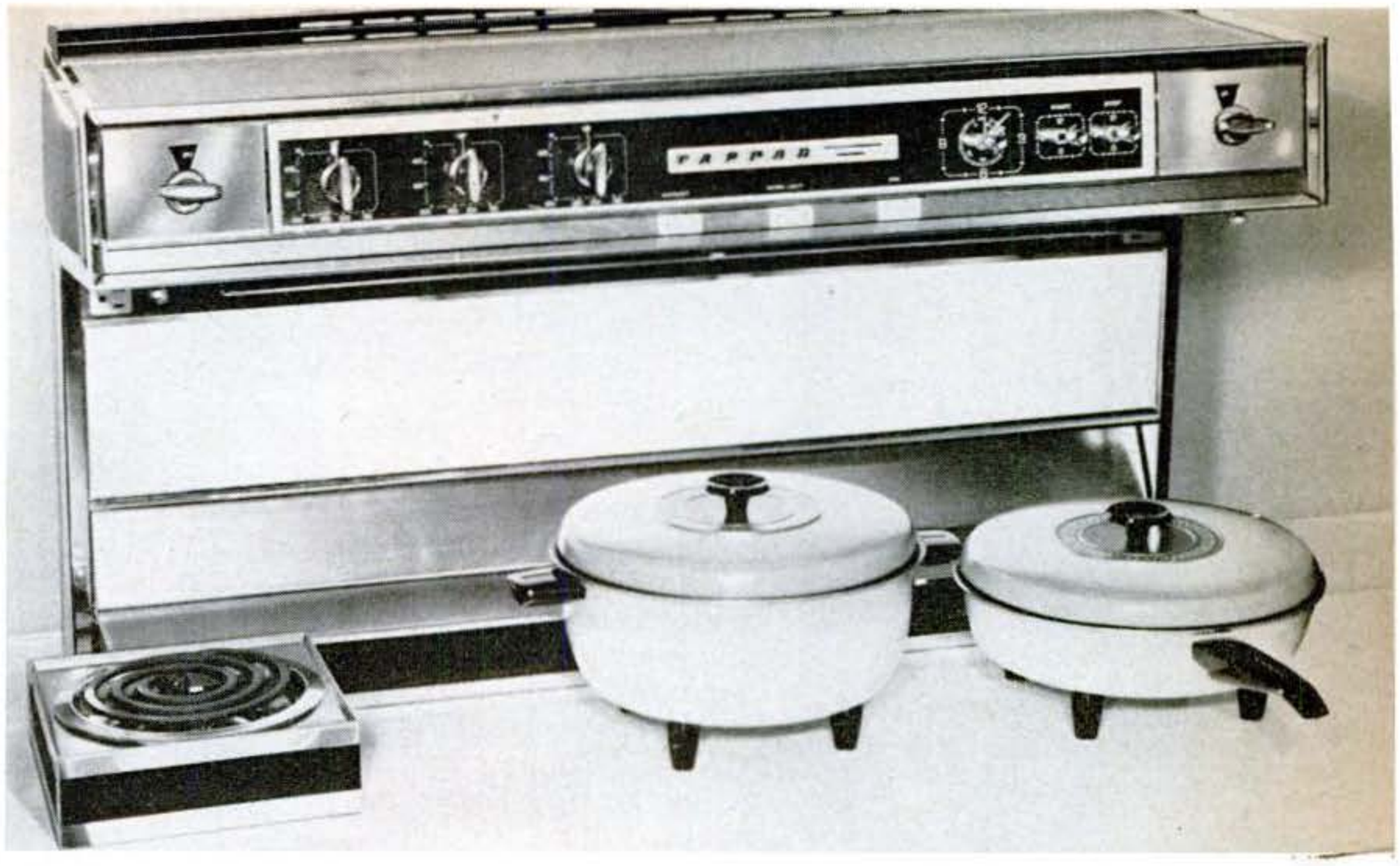
What's New
IN HOME IMPROVEMENT

↑ Little label maker

This midget labeler turns out the same embossed plastic labels that machines many times its size and price do. Dennison's Mini Label-Mate is $1.50. Precut ⅜-inch plastic tapes are 49 cents for 12, at stationery, department, and variety stores.

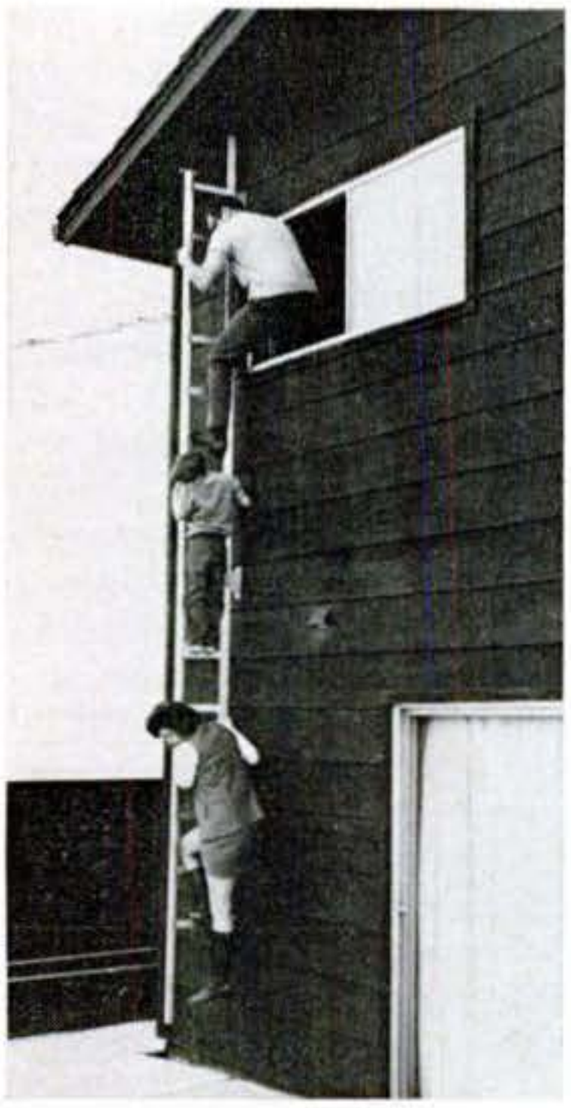


The counter-top range that cooks without burners ↑

If you're looking for the burners on Tappan's new Pan-O-Matic range, give up. It doesn't have any. Instead, cooking is done in five thermostatically controlled pots and pans that plug into a foldaway panel. You dial the temperature you want on a central control panel; the enameled aluminum utensils provide their own heat. If you have a favorite conventional pot or pan you can still use it—on a plug-in-heating element that comes with the range. Advantages of the new system include increased counter space and easy cleanup. A vent hood is standard, and above it is a special shelf that heats to about 170 degrees to keep food and coffee warm. Price? $489.

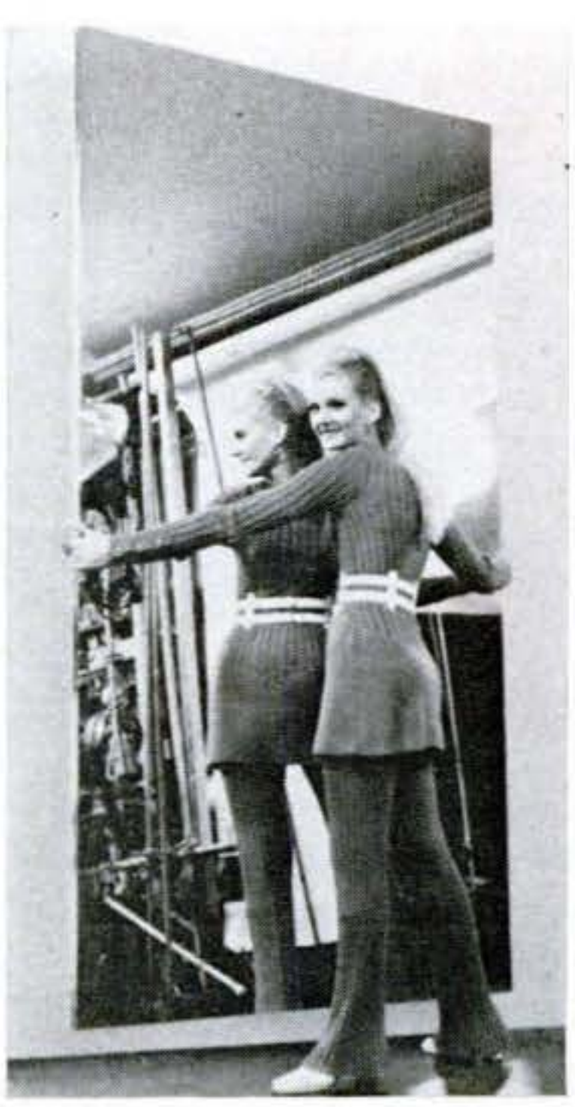
Rip fixer ↑

Got a rip in your car's vinyl upholstery? Naugahyde and Vinyl Repair will mend it almost invisibly with a strong chemical bond. Requires no mixing, and mends leather as well as synthetics. It's $2.25 from Newport Enterprises, Box 286, Orange, Calif. 92669.



↑ Home fire escape

Closed, it looks like a rain downspout. When fire strikes, it opens from the top at the touch of even a small child, providing escape from second-story windows. It's the SureSafe aluminum fire escape, designed for the home. SureSafe, 594 Beatrice St., San Leandro, Calif. 94579.

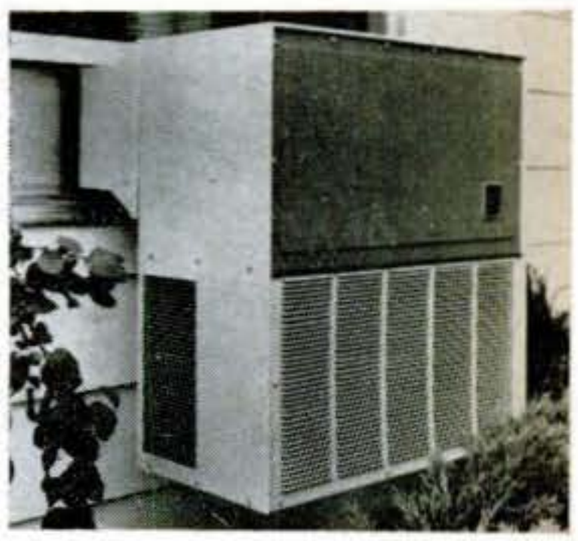


↑ Lightweight mirror

One fifth the weight of glass and almost indestructible, Mirrorlite mirrors are made of a thin plastic film on a metal frame. They provide a reflective surface comparable to glass, and cost less, too, in larger sizes.
Kamar Products, 2 South Buckhout St., Irvington-on Hudson, N.Y. 10533.

↑ Chill chaser

Before you panel your basement rec room, look into Conwed's paneling insulation. It comes in rolls, goes behind the panels and between furring strips to shut out the cold dampness of concrete walls. You staple up the ⅝-inch thick insulation in minutes. Conwed Corp., 332 Minn. St., St. Paul 55101.



↑ Silent space saver

With all moving parts hanging outside the house, the Westinghouse Continental SS air conditioner steals less window space than conventional units. Noise is outside the house and below window level, where it's blocked by the house wall. There are 11,000- and 15,000-Btu models.

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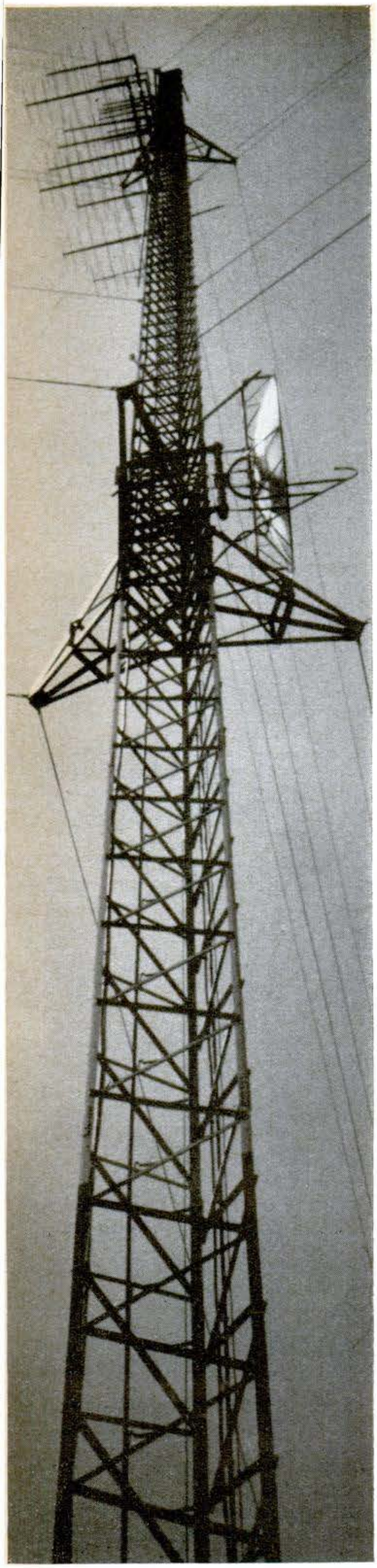

A giant head-end tower, located on a hilltop and actually made up of several specially tuned antennas, is the heart of CATV.

Once just a way to get signals to distant places, cable TV is now growing fast even in big cities. Here's why

CATV Is Coming to

By WALTER G. SALM

One of these days soon, a salesman will ring your doorbell and offer a special service called cable TV. "Why bother?" you may ask. "I'm perfectly satisfied with the reception I'm getting now on my five [if you're average] channels." True, you may be getting good TV reception. But CATV (*Community Antenna TV*) will offer you better reception, and more. Added up, here is what you will get:

- The five channels you would usually pull in with your antenna—but much sharper and clearer.
- Three, maybe four, other stations from other cities. Two or three of them will probably duplicate much of the network programing you're already getting. But one or two may be independents that you have no way of seeing, short of moving to the next town. That's a total of nine channels off the air.
- Three local channels—continuously broadcasting time/weather, news/stock ticker, and local live broadcasts—from town meetings to high-school ball games. That's 12 channels so far.
- There's more coming: pay TV on the cable. This is the most exciting home-entertainment prospect of all. Pay cable channels will cost extra.

Normally, when you hook up to CATV, there's a $20-$30 installation charge. Then there's a monthly rental charge of about $5. That's all until the pay channels come to your cable system—and they're optional, just as the CATV hookup itself was. For an extra $5 a month you can get the movie pay channel, which features a first-run Hollywood movie every night. Generally, the cable may run the same movie for a week, then change.

How cable works. At the beginning of every cable system is the head end. This is a combination super-duper antenna array and very special electronics apparatus in a little doghouse at the base of the tower. The tower is usually on a hilltop or in some other good reception area. It generally holds a separate antenna for each TV channel. Some antennas may be log-periodics similar to the type you might use on your roof—but precision cut for just one channel. Others may be super-gain dish antennas—something like radar antennas in miniature. There will be stacked yagis and folded dipoles and rhombics—a real mixed bag, with each one selected to do the best possible job.

The off-the-air signals are fed separately to preamplifiers to boost the signal and bring it up out of the mud. Next step is down-conversion. The signal is demodulated down to normal video frequency (0-4.5 megaHertz) and then amplified some more. The reason: Video-frequency circuits can strip off the interference, static, and noise that rides in on the carrier, without affecting the picture quality. The entire process is something like the intermediate-frequency amplifier section in any AM or FM radio (and in your TV set).

Once the picture and audio have been processed, the whole thing is remodulated (upconverted) back to its original channel or to some other VHF channel. The picture that goes out on the cable has been reprocessed so much that it's far better than any picture you get with the most expensive private antenna.

The main cables carrying CATV channels are called trunks, and are either buried or strung on telephone poles. These are semirigid cables almost as thick as your wrist, and are often clad in a silvery sheath of aluminum. Every couple of miles, there's a line amplifier in the cable. This is to make up for normal signal losses in the trunk cable. Without these amplifiers, the picture quality would be pretty miserable by the time it reached the subscribers farthest from the head end. As it is, systems are generally designed to use no more than 10 amplifiers in any length of a trunk. This is because a little noise creeps into the line each time the signal is amplified. (Noise to a cable man means little bits and pieces of interference in the picture, not in the sound.)

The cable drop. The spot where a cable leaves a secondary feeder cable for your house is called a drop. The drop consists of a small, metal box mounted on the cable with a small-diameter coaxial cable going from the box to your house. The drop cable is usually RG-59/U—the same coaxial

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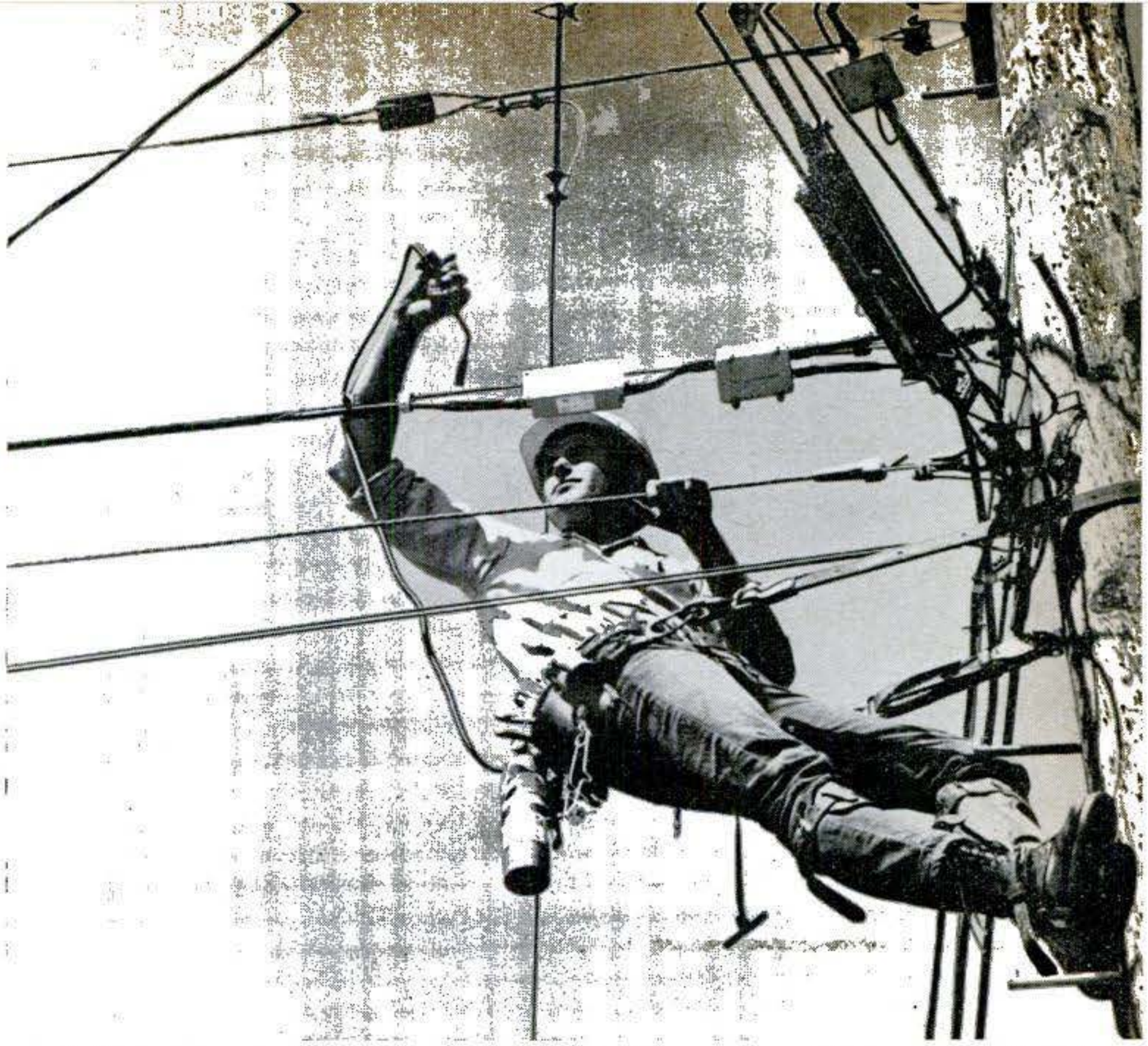
Your Town

Machines can bury cable leading from the community antenna out of sight, barely leaving a trace where they cut turf.



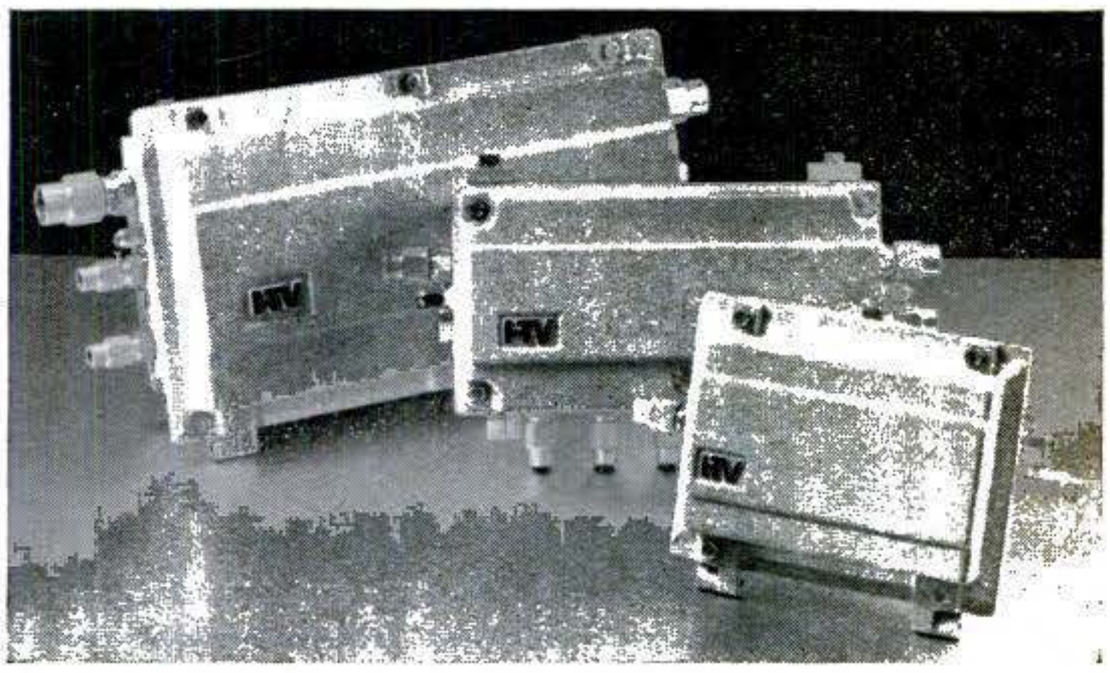
Trunk lines are usually strung on utility poles already set up for phone and power lines. Here, workman is installing a line amplifier on a trunk line. A secondary feeder line leads out of the main trunk, widening the area served by the community antenna.

cable people use in their antenna lines instead of the usual twin-lead ribbon. The cable is an unbalanced line—one conductor (the outer shield) is grounded while the inner conductor is "hot." Co-ax has an impedance of 75 ohms. Flat twin lead is a balanced line—neither side is at ground potential—and has a 300-ohm impedance.

Most TV sets have an antenna impedance of 300 ohms to match the more common 300-ohm twin lead. To connect the CATV co-ax to your TV set, a tiny transformer is used right at the antenna terminals.

Big-city problems. In New York City and other large cities, the picture problems aren't due to poor signal strength but to the many reflections and shadows from tall buildings. Pictures come in with interference lines, triple ghosts, hash, interference stripes, and assorted other ailments. There may be plenty of signal strength on channel 2, but the picture looks awful. Now, suppose a cable system pumps in this station on the same channel 2. There's so much signal in the air that it will be picked up by the TV set and cause serious interference with the signal on the cable. This is where the set-top converter comes in. Back at the head end, the electronic gear doesn't remodulate the picture back to its original channel. Instead, it puts the picture on a much lower frequency, below the TV band, or even up in the low end of the UHF band. To pick

[Continued on page 120]



Line amplifiers like these are installed at intervals along the cable to make up for normal signal losses. Amplifiers shown here are also equipped with drop taps for coaxial antenna cables leading to the customer's home. Larger units have multiple taps, smallest has one.

Typical cable-TV control room has video and audio recorders, monitors, and tape editors Many are equipped to handle color.

Motion-picture and slide multiplexers provide cable stations with facilities for producing filmed program material.

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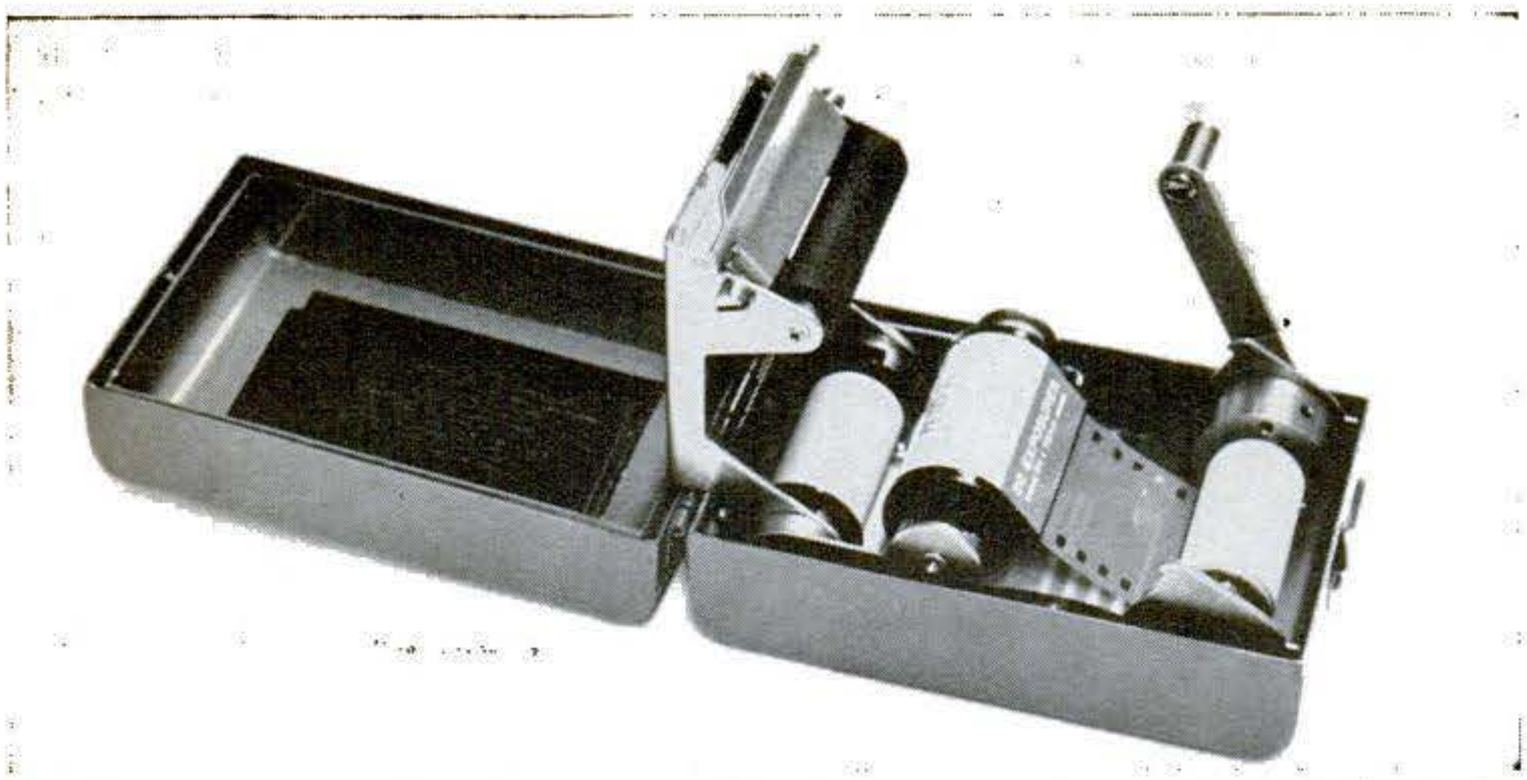


PoroPak processes a 36-exposure roll of black-and-white film in 15 minutes. You open the case, insert and thread film and processing mat (above). Swing down the roller assembly (below, left), close case, crank film and mat onto take-up spool.

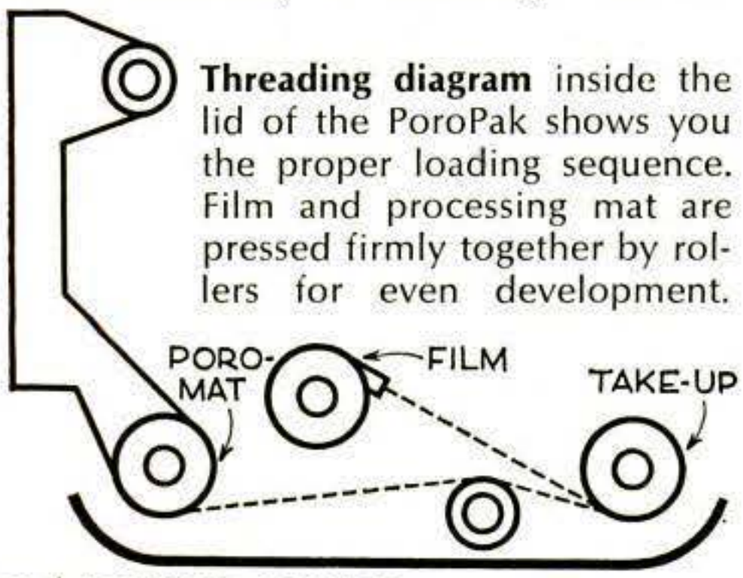
PERSONAL-USE REPORT

This Darkroom Travels in Your Pocket

I've been developing 35mm film in my pocket lately. It's easy and messless—with the new PoroPak processor. Smaller than most cameras, the machine can go with you into the field to soup your film as soon as you shoot it. You see the negatives in minutes and, if necessary, can reshoot while you're still on the scene.

What's more, there's no easier way to process film. You can do everything in daylight, and the machine can't be loaded improperly, even if you try.

What really does the processing is the PoroMat, a rolled-up web of porous plastic saturated with a monobath solution. You place the film cartridge and processing web on their respective spindles. Then you thread the film and web onto a take-up spool, and lock them into a roller assembly. Close the cover and crank the film and mat through the rollers onto the take-up spool.



Threading diagram inside the lid of the PoroPak shows you the proper loading sequence. Film and processing mat are pressed firmly together by rollers for even development.

In 15 minutes your film is developed, cleared, and damp dry. Additional processing time has no effect. In another 15 minutes the film is dry. Unwashed, it will maintain a stable image for about six months. For greater permanence, you can wash the film at any time within six months.

Picture quality in blowups I made from Poro-processed film compared favorably with prints from my conventionally processed film.

Townley Chemical Corp., 115 Albany Ave., Amityville, N.Y., makes the PoroPak in limited production for $150. With sufficient demand, a plastic version could be produced at much lower cost.—*Paul Wahl*

CAMPING—

By **JIM DAVIS** / *PS West Coast Editor*

Your motorcycle can be a passport to travel adventures beyond the reach of a family car. Maybe you think camping's a drag, and can't see slowing yourself down with a four-wheel vehicle to piggyback or tow a rig that boasts all the comforts of home. But how about motorcycle camping?

Add the mobility of your bike to the camping scene and you'll find yourself zooming off to places you'd never take an ordinary rig. And you needn't rough it, either. Space-age technology has brought such lightweight compactness to camping gear that you can pack along all essentials.

There are three basic ways to go camping on your bike. First, you can carry all your gear on a luggage rack, in pannier-type saddlebags, in a backpack—or a combination of these. The second method is to attach a sidecar to the motorcycle, put your passenger behind you, and load the sidecar to capacity. The last—and newest—method is to hook on a sleeping trailer and go in style.

Modern tents, made from plastics and nylon, weigh under six pounds, yet offer full shelter from wind and rain. A few years ago, the same size tent weighed 20 pounds or more. Ground covers are no longer canvas but ultra-thin sheet plastic. Lightweight "space blankets" now take the place of bulky wool ones. There are plastic containers for everything, fold-up propane stoves, freeze-dried foods, featherweight sleeping bags. And if you *do* want to bring along the major comforts of home—including your wife—a trailer is an ideal solution for you.

I've crossed the United States twice pulling a bike trailer, so I've got a fair idea just how they handle. My personal preference is the two-wheel variety—it doesn't depend on the motorcycle itself for stability. Even so, I've found single-wheelers are just fine as long as you don't overload them. One of my favorites is the Hobo Hunter (made by Cycle Tow Trailers, 456 No. 35 St., Seattle 98103). It's merely a wheel, hitch assembly, and a well-made tubular frame designed for hunters who couldn't get large game out of the woods on their bikes. It has a carrying capacity of 250 pounds, yet is only 40 inches long, 27 wide. Suspension is by a spring-loaded swinging

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Now Try It On Two Wheels

Whether you tow a trailer for two, or pack a solo tent in your saddlebags, it's great

Tent trailer for motorcycles weighs only 360 pounds and folds to low profile—32 inches from roadbed—for travel. At camp, it converts into covered wagon (right photo) to provide ample sleeping room for two, with full privacy. Note telescoping rear slide to increase length. Cover snaps on over metal bows. Folded trailer has 21 cu. ft. of space for gear—camp stove, ice chest.

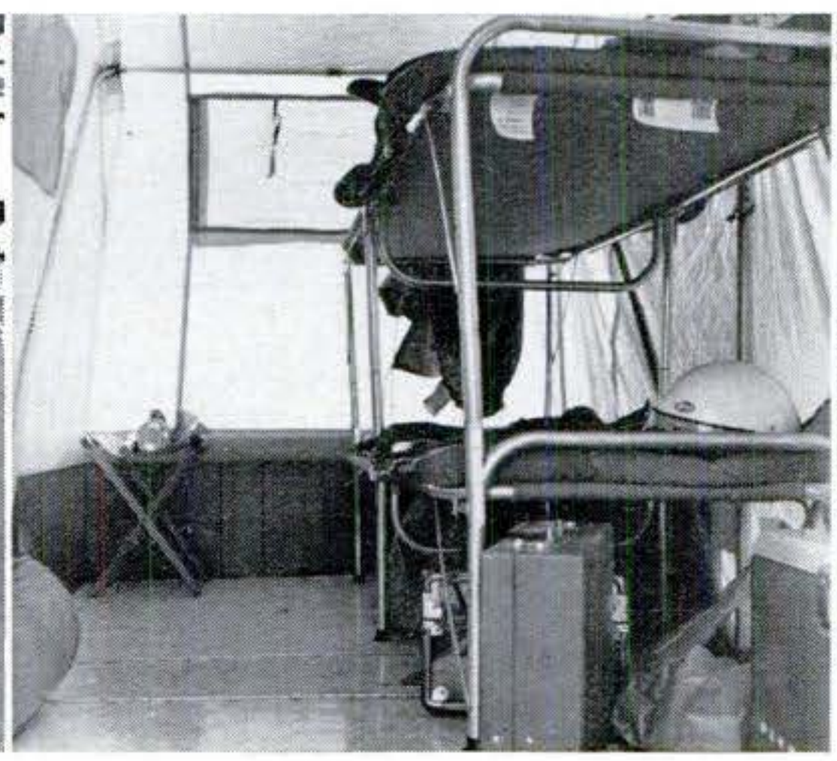
arm. You can anchor your load with straps or bungee cord—or bolt on a box. The same company offers other models with big lidded boxes of tough plastic. The six-cu.-ft. version is the Sportster; the top of the line handles over 10 cu. ft. Both of these come with a 12-volt electrical system, including turn signals.

The two-wheel sleeping trailer at the top of this page is built by Wheel Mate Corp. (Box 34, East Petersburg, Pa.) and sells for around $480. As optional equipment, you can get ski and surfboard racks, a spare tire, or a large canopy fly.

Any trailer should be loaded for balance, with the weight over the axle. On single-wheelers, see that the hitch is bushed (free-floating) or the trailer will shake your fillings loose. Keep your ball hitch well lubricated—and don't hot-rod around curves.

Half-igloo tent has lightweight fiberglass ribs, offers bugproof shelter for a single sleeper. Folding stove, left, burns propane. All gear shown packs into panniers at right.

Homebuilt trailer, loaded with complete camping gear, weighs under 300 pounds and tows easily behind Harley 74. Ball hitch pivots against lean of cycle around curves.



Double-bunk tent is most spacious of bike campers. Hinged bed of two-wheel trailer folds out to form wide floor of conventional peaked tent with roll-up window flaps.

Midget travel trailer is commercial scale-down of type made for car towing—even to propane tank on the hitch. It's a home you can leave in camp—locked—while you roam.

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FOR LAZY-MAN LAWN CARE—

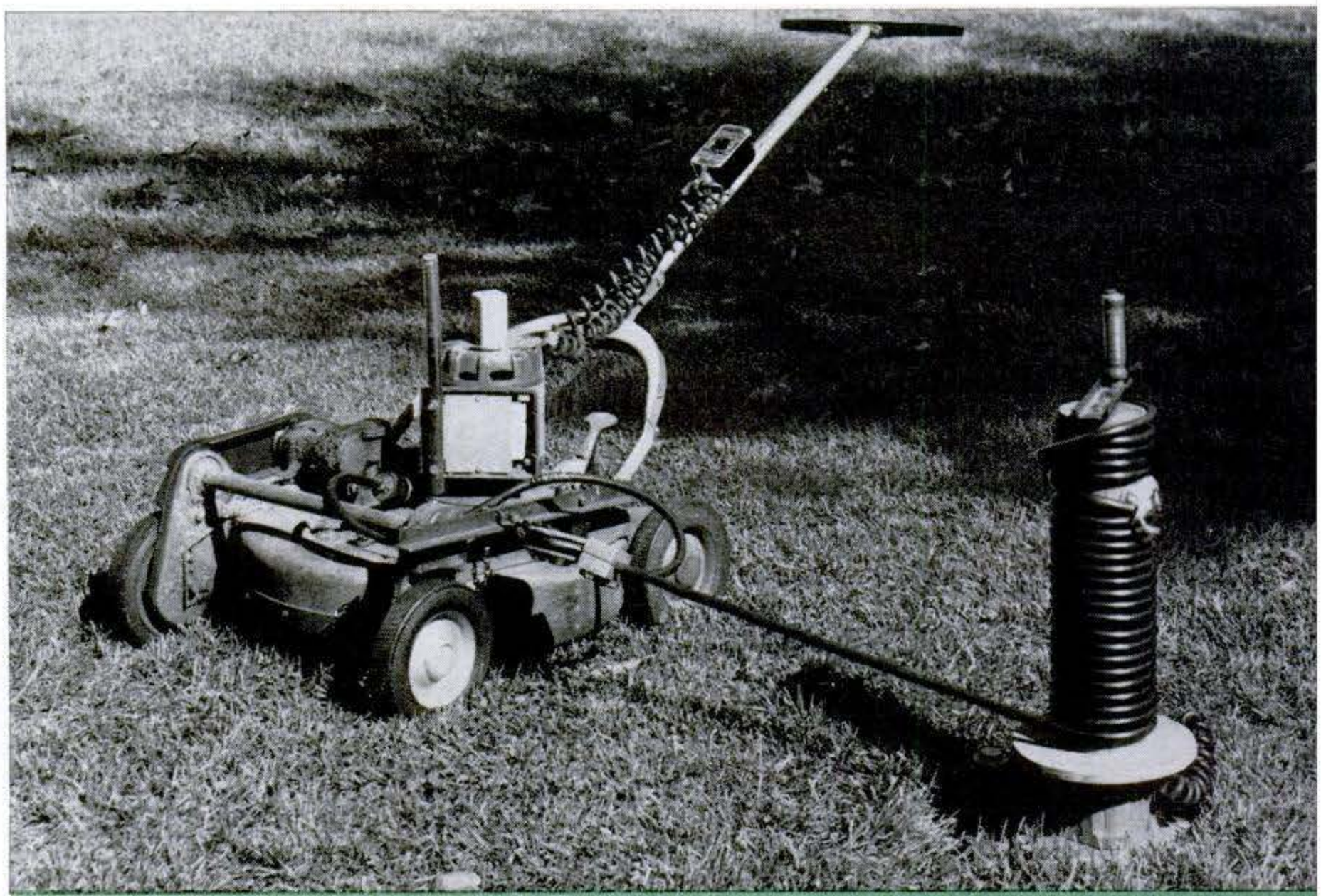
More Tethered Mowers

The readers of PS are an ingenious lot. Ever since we showed two no-sweat ways to cut grass ["Tethered Mowers Go Around and Around," PS, Aug. '69], we have been getting suggestions for improving the tether system. We sorted through them all and picked out what we thought were the two most interesting.

One system showed how to use electric mowers, and even fertilizers, on a tether. Electrics are naturally suited to this application—the power cord doubles as the tether.

The other suggestion covers a system for mowing rectangular lawns without moving the tether reel. Instead of mowing several overlapping circles, this refinement lets you mow an oval.

We are passing along these two ideas with the expectation that they will lead many of you to still further refinements in the art of avoiding mowing monotony.



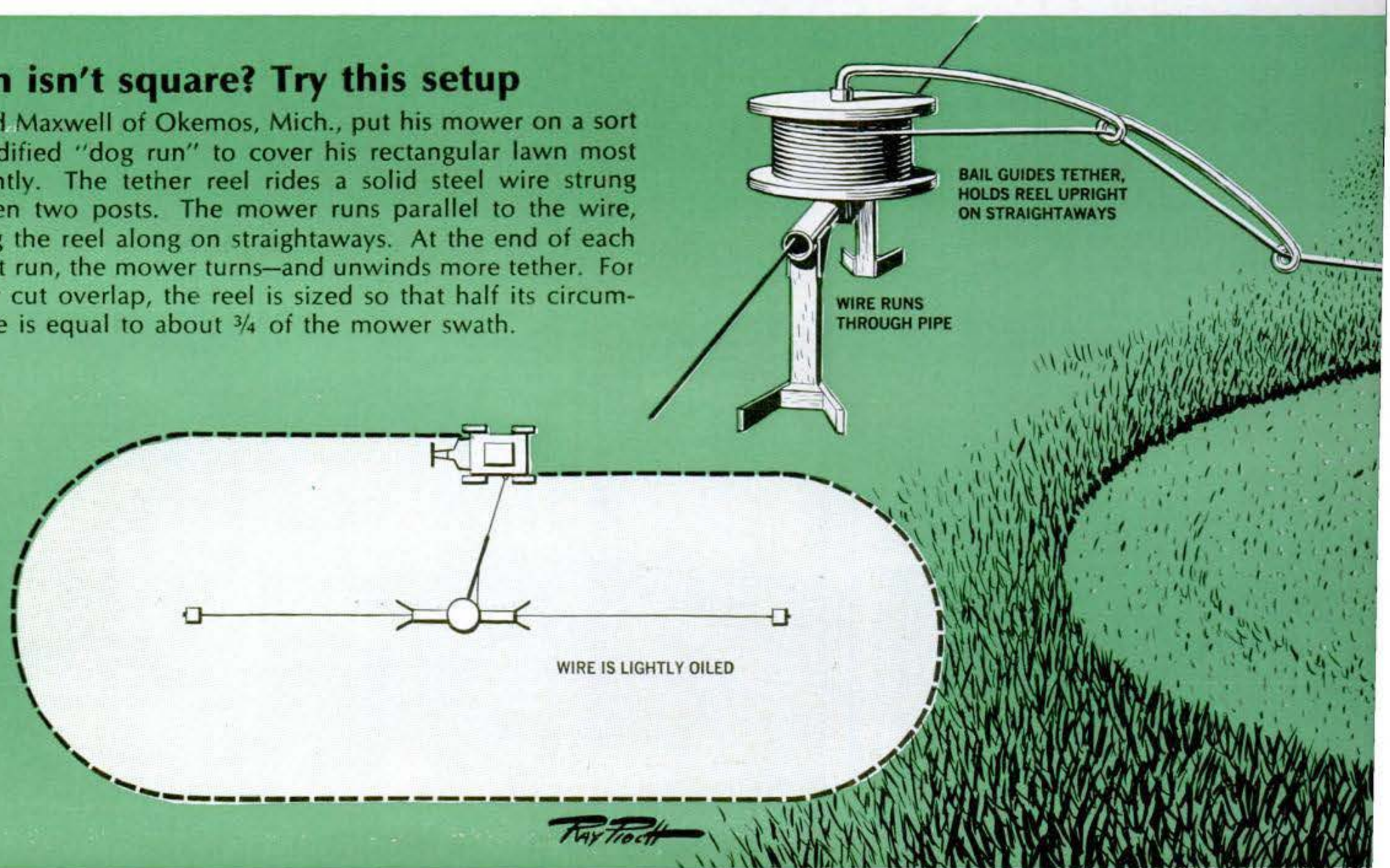
Electrics are naturals for tethered mowing

PHOTOS BY EDWARD A. WESCH JR.

Carl Olander, Dumont, N.J., has been using the tether system for 28 years. His electric mower unwinds itself in ever-widening circles from a cord-storage reel in the center of his circular

Lawn isn't square? Try this setup

Donald Maxwell of Okemos, Mich., put his mower on a sort of modified "dog run" to cover his rectangular lawn most efficiently. The tether reel rides a solid steel wire strung between two posts. The mower runs parallel to the wire, pulling the reel along on straightaways. At the end of each straight run, the mower turns—and unwinds more tether. For proper cut overlap, the reel is sized so that half its circumference is equal to about ¾ of the mower swath.



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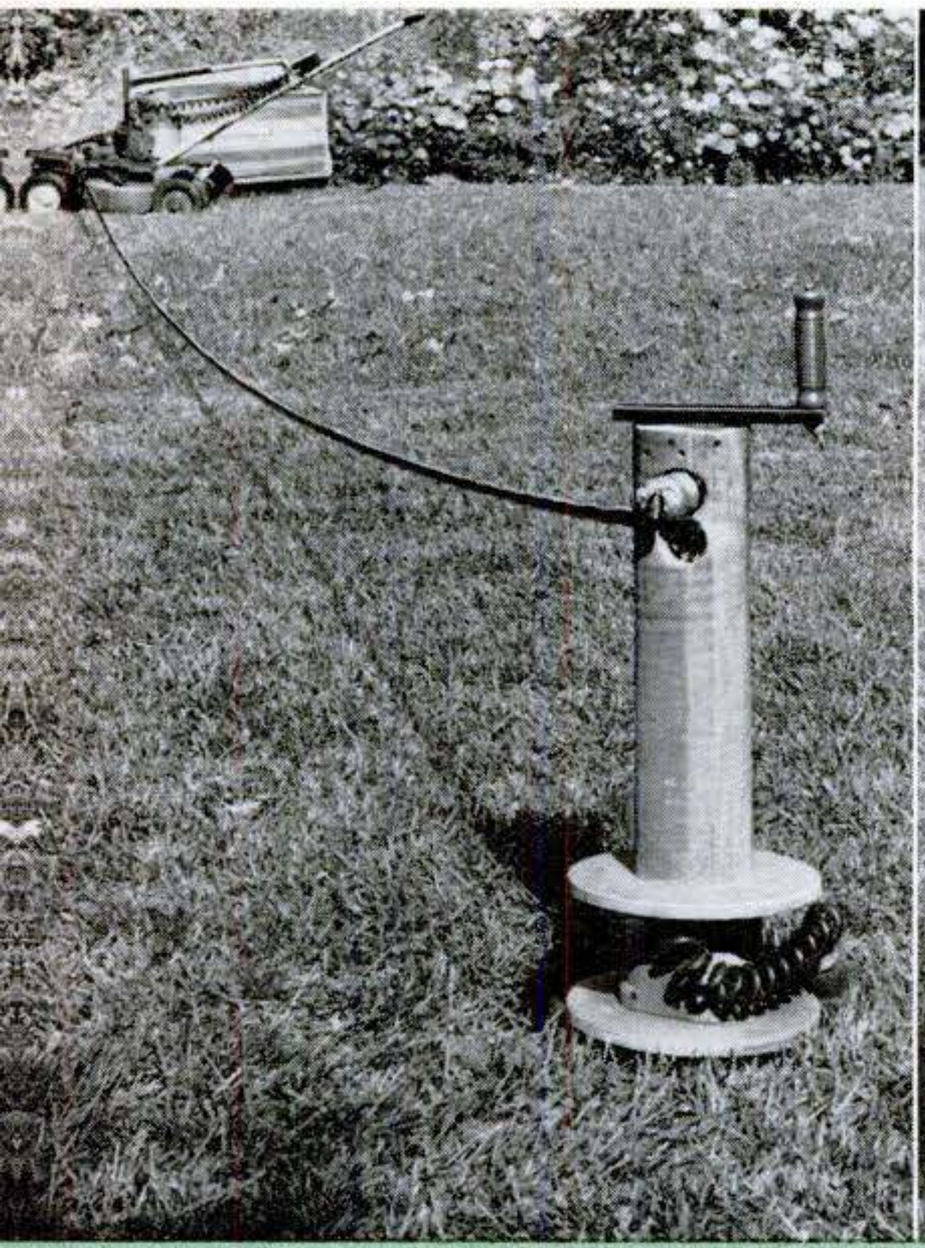
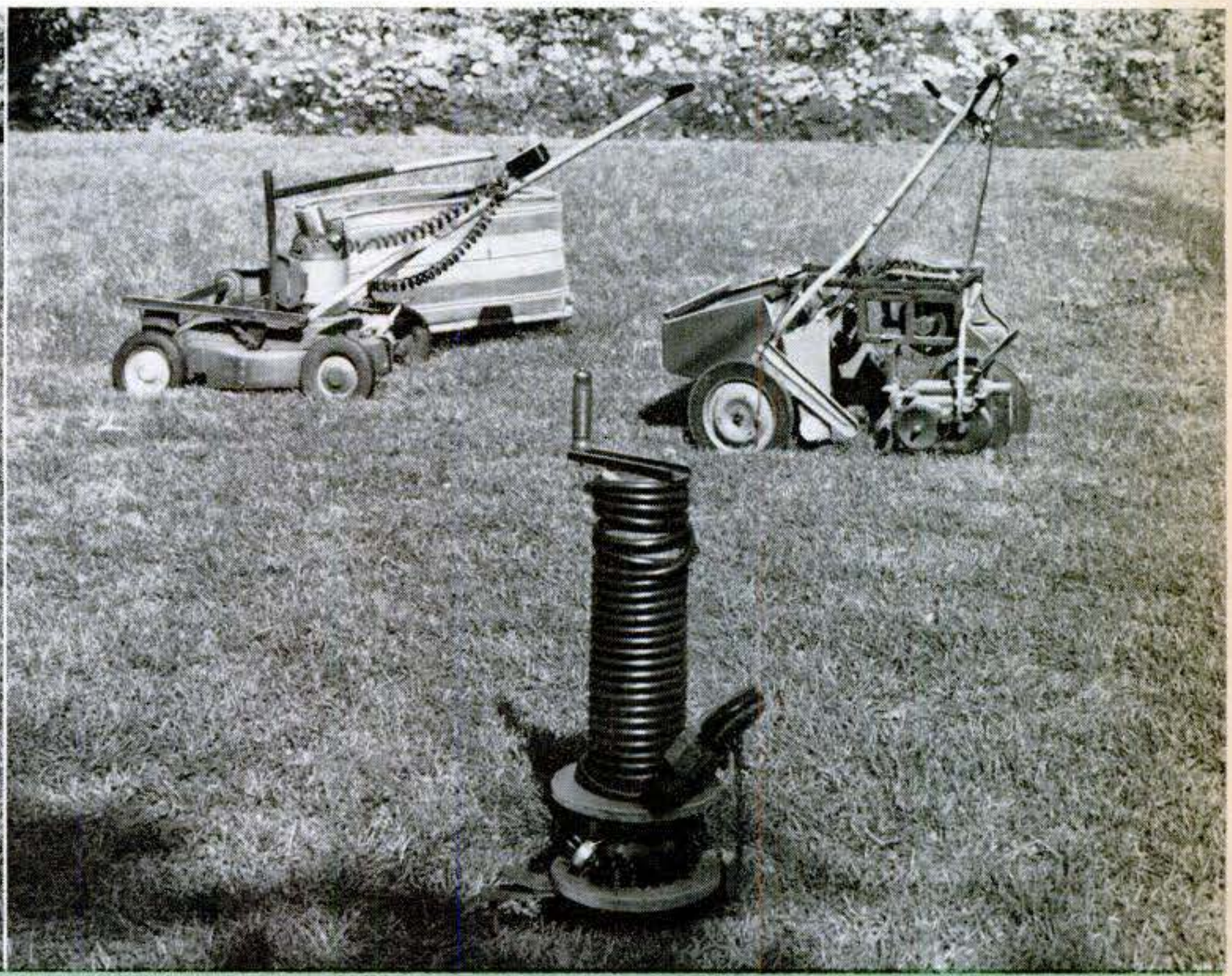
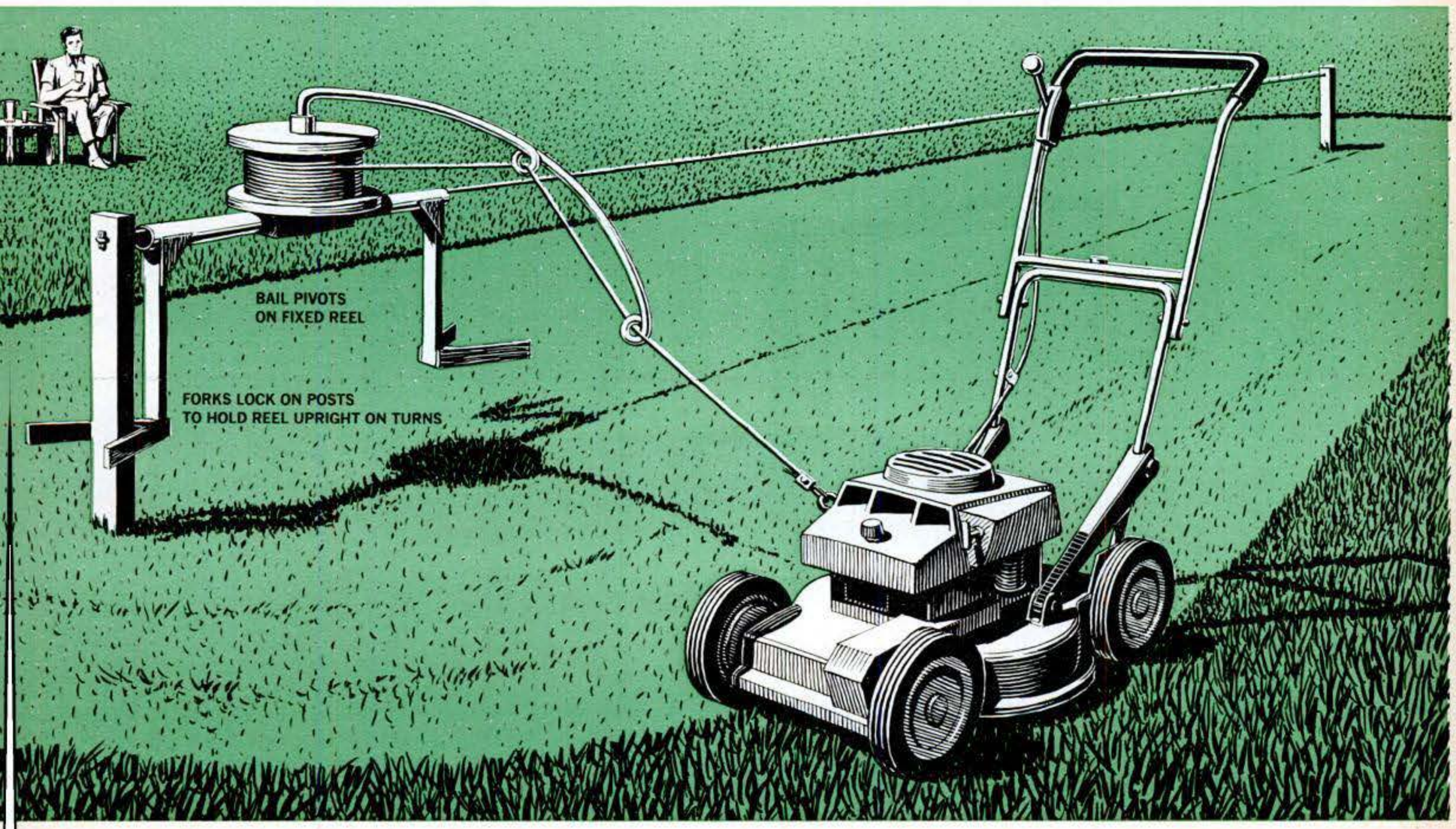
Make the Rounds





llawn. He has incorporated a deadman ocontrol—the mower shuts off automatiocally if the tether goes slack. At the end of the last turn around his yard, the mower pulls out its plug and stops in front of its storage shed. A crank on the reel makes it easy to rewind the cord when the job is done. Mr. Olander has also devised an electric fertilizer to run on the same power-cord tether. Going even a step further, he rigged a walking sprinkler (not shown) that swings around his yard on the end of a 22-foot water-pipe tether. There's seemingly no end to tethering tricks.



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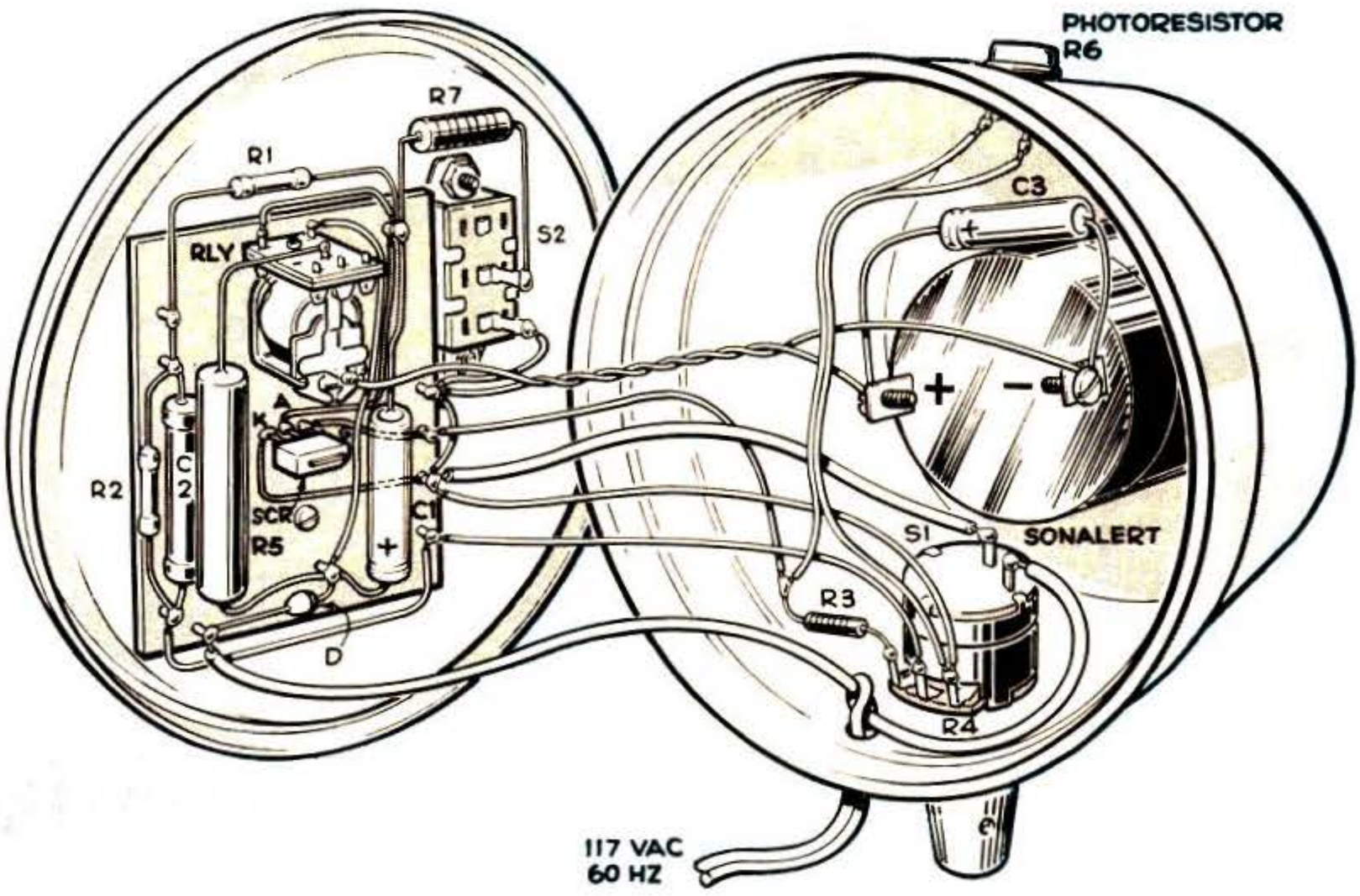
Alarm Keeps Its Electric Eye Out for Burglars

And helps you keep track of your kids, too

To adjust for most sensitivity, turn knob until the Sonalert sounds off. Then back off on adjustment just enough to silence alarm.

Switch sets alarm to sound off either momentarily or continuously when tripped.



By RUDOLF F. GRAF
and GEORGE J. WHALEN

The electric eye in this alarm can spot any burglar who casts a shadow. The circuit is so sensitive that a street light shining through a window provides enough light to trigger the alarm when a man—or even a cat—passes by and casts a shadow on the eye. The alarm's use is not limited to burglar detection—it can warn you if your children wander into your shop or other potentially dangerous areas in the home.

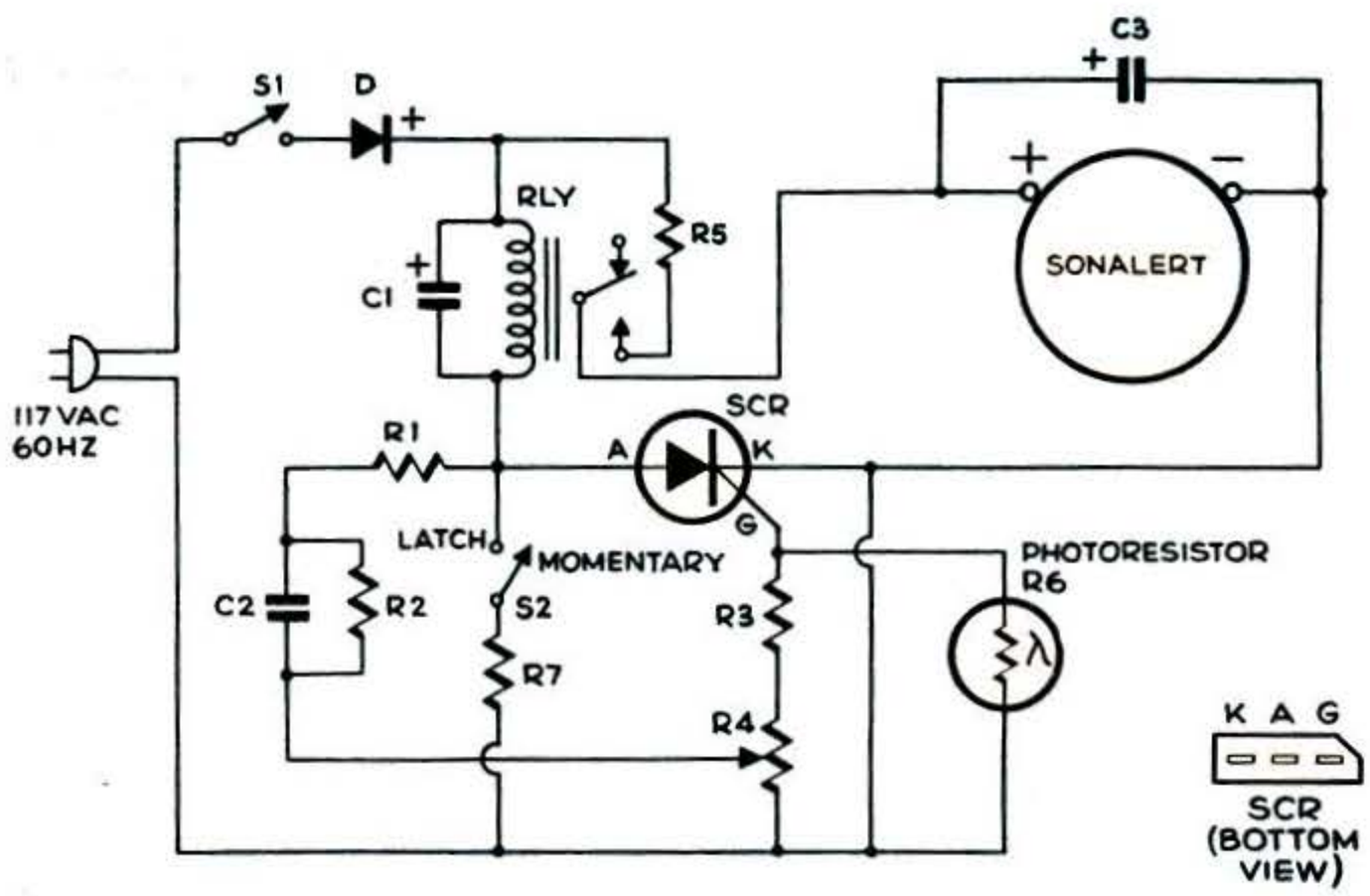
The alarm's excellent sensitivity is obtained by using a silicon-controlled rectifier in a manner other than its usual switching mode. When an SCR is operating at very low current levels, it can be considered to be a complex amplifier made up of two transistors with their inputs and outputs connected for high regenerative feedback. In this application, the SCR can have enormous gain. This is the principle behind the sensitivity of the alarm.

Specifically, here's how the circuit works: The SCR is operated from the AC line. Diode D in series with relay RLY receives slight positive pulses each time the line swings positive. These pulses are applied to the anode of the SCR.

A network consisting of resistors R1, R2, and capacitor C2 couples a

PARTS LIST

D—Silicon rectifier diode (GE type IN 5059)
C1—20-mfd., 150 WVDC electrolytic capacitor (Sprague TE-1509)
C2—.22-mfd., 200 WVDC mylar capacitor (Sprague 192P22492)
C3—25-mfd., 50 WVDC electrolytic capacitor (Sprague TE13055)
SCR—Silicon-controlled rectifier (GE type C106B)
R1,R2—100-ohm, ½-watt, ±10% carbon resistors
R3—4.7-ohm, ½-watt, ±10% carbon resistor
R4—5-ohm linear-taper potentiometer (Mallory U12)
R5—5-ohm, 2-watt, ±10% carbon resistor
R6—Photoresistor (Clairex CL5M4)
R7—15-ohm, ½-watt, ±10% carbon resistor
Sonalert—Mallory SC-628P
S1—US-26 SPST switch
S2—SPST slide switch
RLY—Relay (LaFayette 99T6091)
Misc.—Line cord, plastic case



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portion of the pulses reaching the anode to potentiometer R4. The setting of this pot determines what percentage of these pulses is fed to the gate of the SCR. Resistor R3 limits the maximum pulse excitation that can be applied to the gate.

Shunting R3 and R4 is photoresistor R6 (the electric eye). This photocell has a high resistance when little or no light strikes the sensitive surface. Resistance decreases as the light level rises.

In operation, R4 is set so the SCR receives almost (but not quite) enough positive pulses to cause regenerative feedback. Enough current passes to hold RLY open.

But now the slightest reduction in the amount of light striking the photoresistor (caused by a burglar's shadow, for example) will increase its resistance. This permits higher-level pulses to appear at the SCR gate and regenerative amplification begins.

Now the SCR draws enough current to close RLY. This allows positive voltage from the diode to activate the Sonalert.

Setting up. To get the most out of this sensitive alarm, you have to set it up properly. This simply involves placing the alarm in a good location, and setting the potentiometer R4 to the right level. Wherever you place the alarm, make sure there is at least some light falling on the eye. At night this could come from a streetlight outside your home or a low-wattage bulb you leave on just for the purpose. During the day, face the eye toward a window.

You'll have to adjust R4 differently under varying light conditions. With a normal daytime setting the alarm will set itself off when darkness falls. To set the circuit for the highest sensitivity, turn R4 until the Sonalert sounds off. Then back off on the adjustment until the alert stops. Test the alarm: Passing your hand in front of the eye should trigger it.

Switch S2 lets you control the type of signal the alarm gives you when triggered. When it is left open, the Sonalert will signal only while the light falling on the eye is lowered—when someone is actually in front of the eye. Once he moves past the alarm the signal will stop. This open position—called the "momentary" setting—is handy if you use the alarm to keep track of children. Place the alarm at the door to your workshop or other parts of your home off limits to children and it will warn you when the kids are getting into mischief.

When S2 is in the closed or "latch" position, if triggered the alarm will sound continuously until you shut it off. This is the best setting for use as a burglar alarm.

Trailer-Hitching Guide Puts You Right on Target

How quickly can you hitch up your trailer? Without a helper to guide you, it probably takes a few tries, backing and filling, to get the hitch ball aligned with the coupler. And even with help, you probably end up hauling the tongue the last foot or two by hand.

Here's a hitching guide that's patterned after the device used by Apollo astronauts to aid in mid-space docking maneuvers. It uses the principle of triangulation to make hitching so simple you can do it the first time you try.

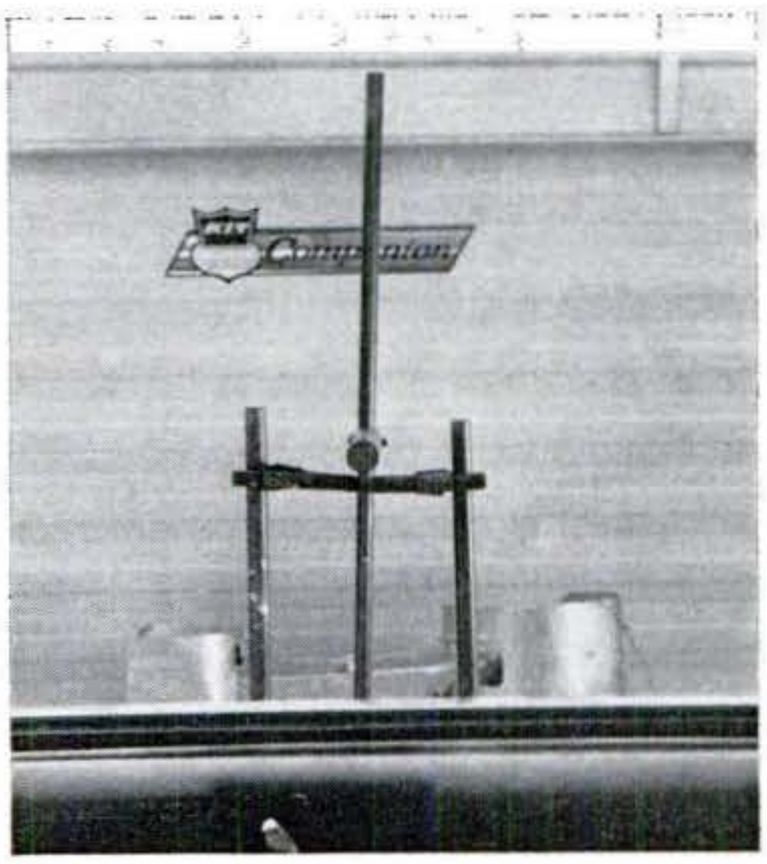
Constructing the guide is easy. See the drawing below for details. It's a good idea to paint the guide a bright color for visibility. This is especially helpful when hitching in the dark.

To prepare for hitching, clamp the dowel holders on each side of your hitch. With the car and trailer on level ground, adjust the clothespins and the target dowel to the same height—about eye level when viewed through your rear window from the driver's seat.

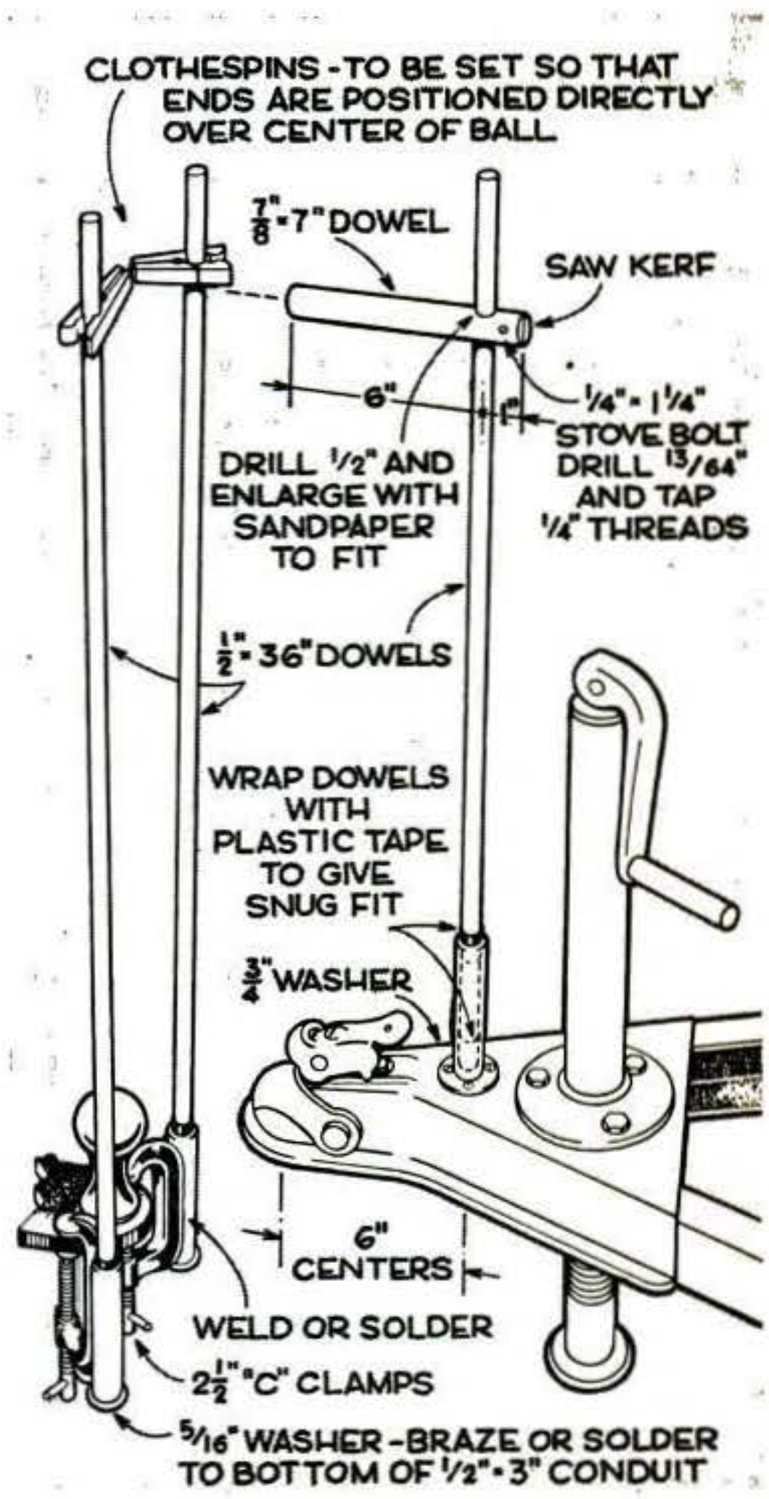
Position the clothespins so their free ends meet directly over the hitch ball. Check this by using a piece of string and a nut as a plumb bob.

With the pins over the ball, and the target dowel over the ball cup, all you have to do is back up, sighting the target dowel into the center of the pins. Stop backing when the dowel just nudges the pins. Now simply lower the tongue of the trailer onto the hitch ball, and you're ready to go.—*Clifford G. Hansen*

Here's what you see out the rear window as you back into position. Simply steer to guide the dowel between clothespins.



Guide looks like this when you have backed into perfect position. Notice that target dowel is exactly centered in clothespin V.



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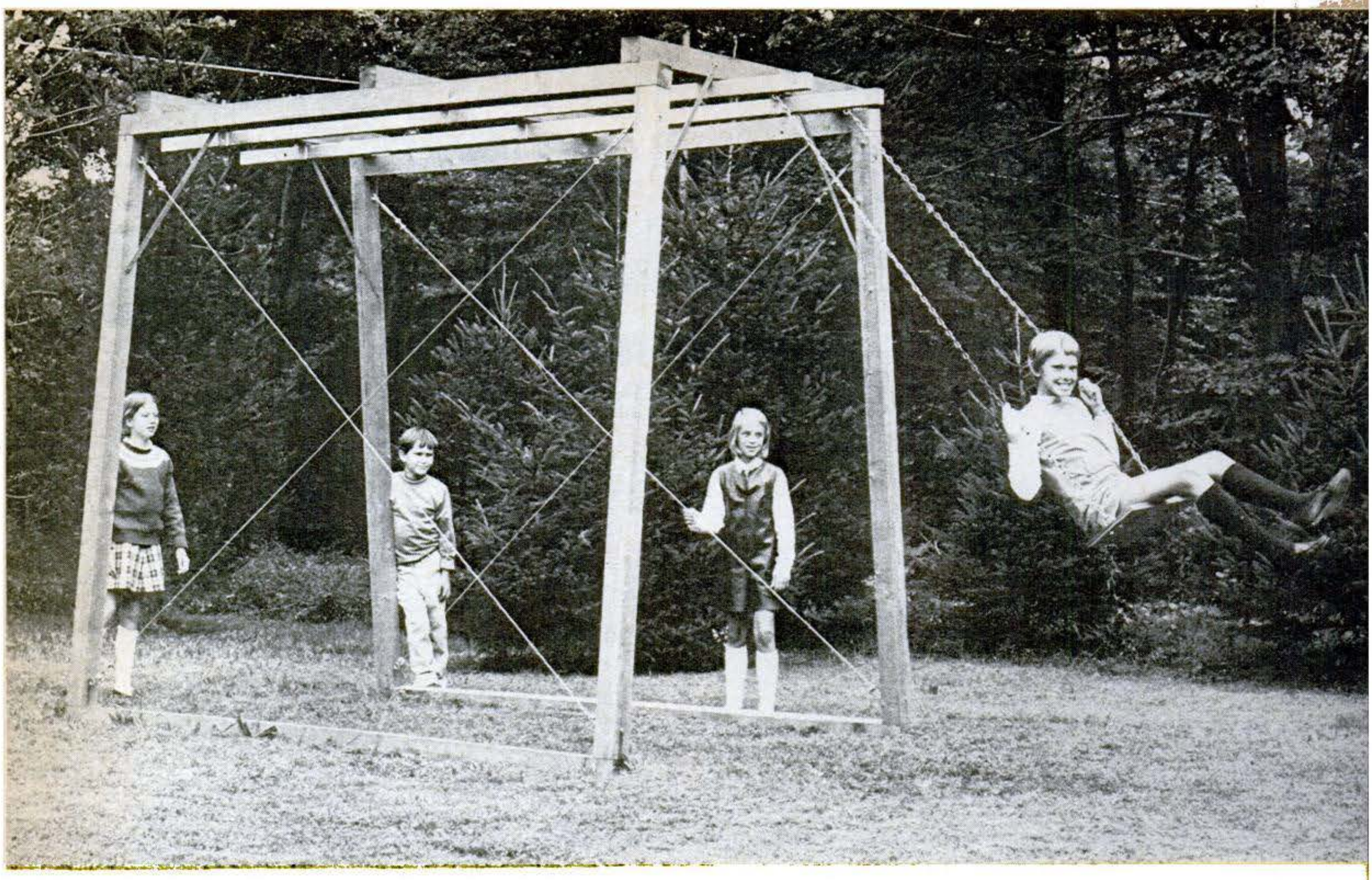

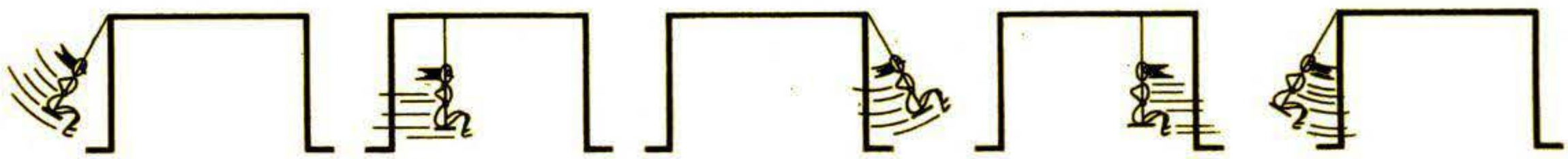

FOR BACKYARD THRILLS—

Build a ZOOM SWING

Hang a swing from sliding-door track to add zip to ordinary pendulum action

By JACKSON HAND

Living in an era of mind-boggling technological advances, you didn't expect the old-fashioned backyard swing to go unchanged, did you? Well, it hasn't. Down in New Zealand, a transplanted Canadian by the name of Al Forbes has perfected a swing that doubles the pleasure, doubles the fun of any young swinger.

Instead of hanging from a stationary beam and swinging like a pendulum, the Forbes Zoom Swing is suspended from a pair of rollers running in a pair of tracks. You start your ride as with any swing, but then —presto, chango!

Riding the track. Instead of bottoming out when you get close to the ground, you zoom the length of the track, then up—then down, to zoom back and up—as shown in our sketches above. You can get five or six runs out of a single start, and with a little practice you can pump, the same as you used to do with those model-T swings you enjoyed so much. Today's kids, naturally, catch on immediately, and the neighborhood moves in. Including those swinging teen-agers.

Al Forbes turned the idea over to POPULAR SCIENCE, and the editors asked me to build a Zoom Swing on strictly home-handyman terms. I settled on cedar four-by-fours, with diagonal bracing of 1/4" cable with turnbuckles. Everything goes together with heavy lag screws, and there are only two critical aspects:

- The roller hardware is even more important than you'd think. I tried a good set of nylon-bearing rollers and the action fell flat. Then I visited a building-hardware outlet and bought a pair of precision-made ball-bearing rollers. They are Stanley's BBXT2600 hangers, worth the $15 they cost. The track—also Stanley's—runs about $1 a foot.
- To facilitate cutting the four-by-four stock, I kept everything at 90 degrees, despite the splay in the two

[Continued on page 113]

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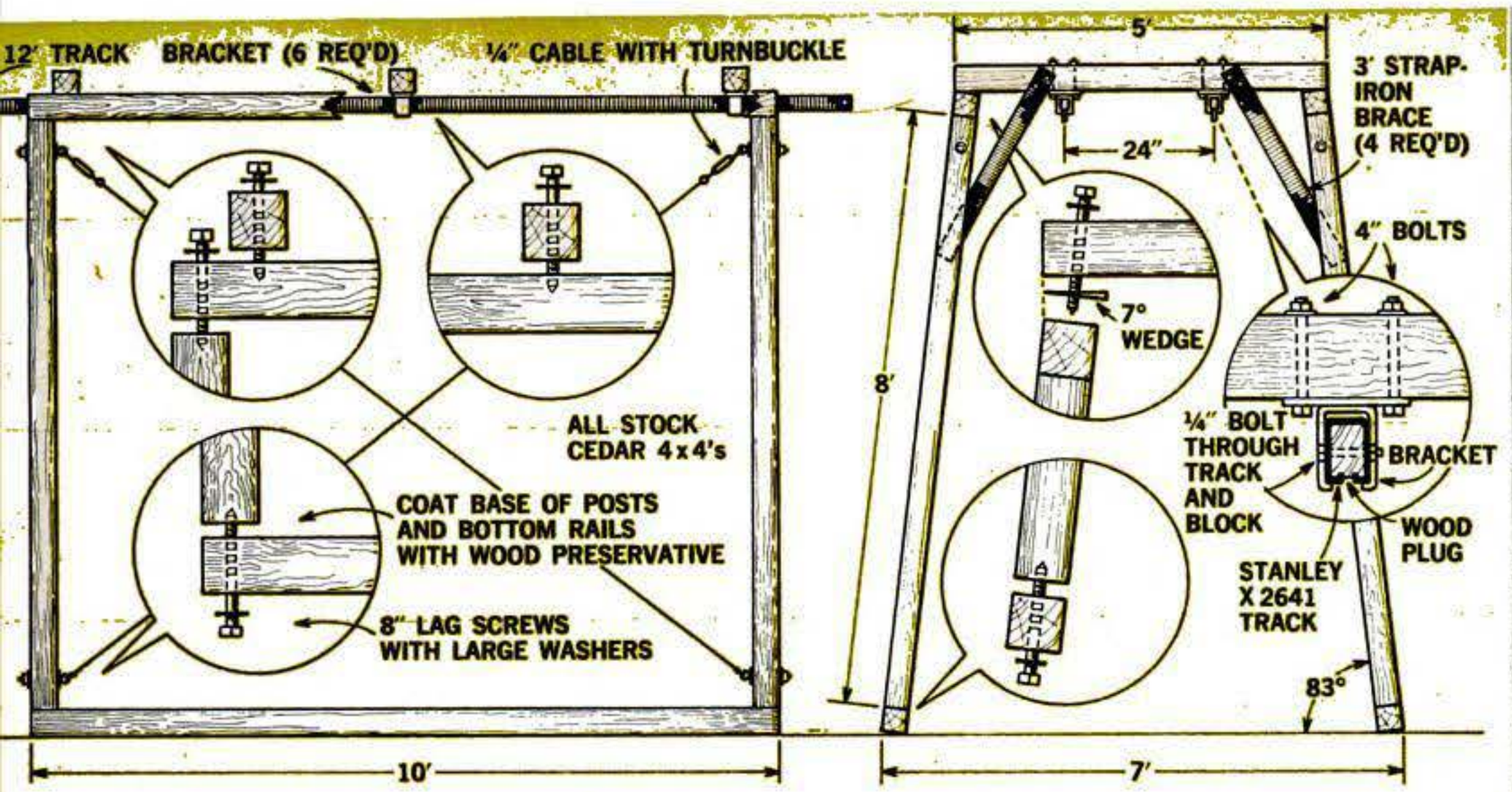
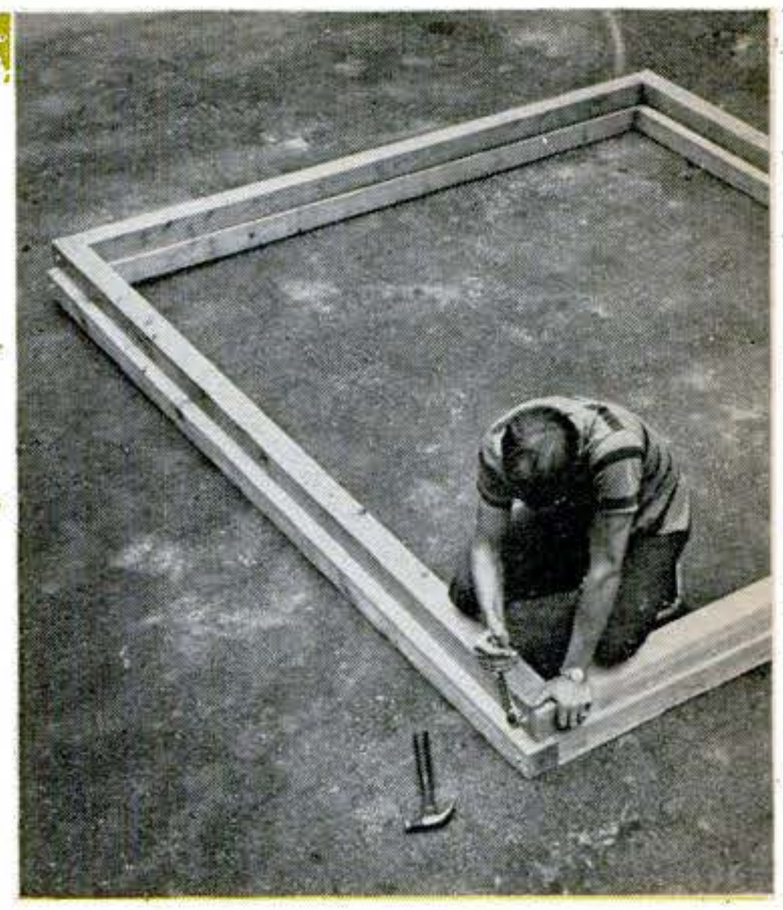
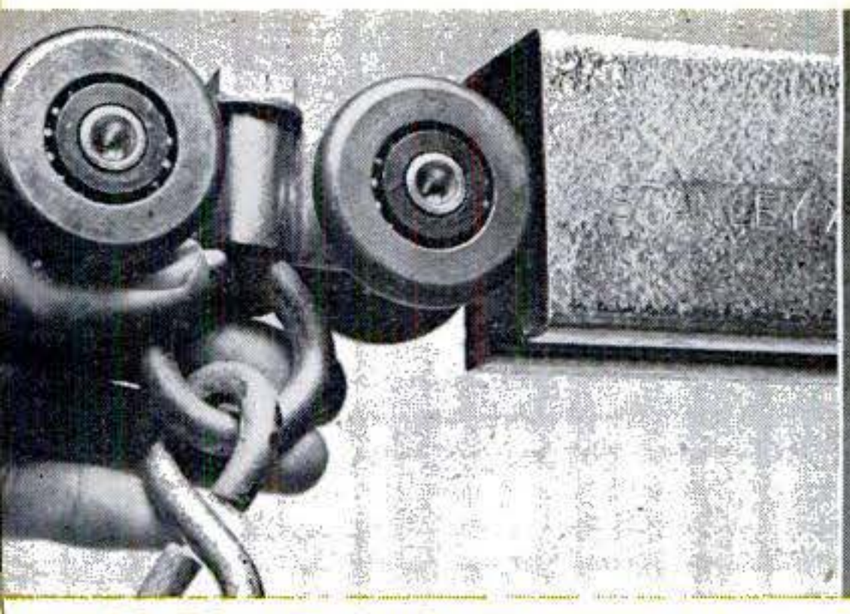


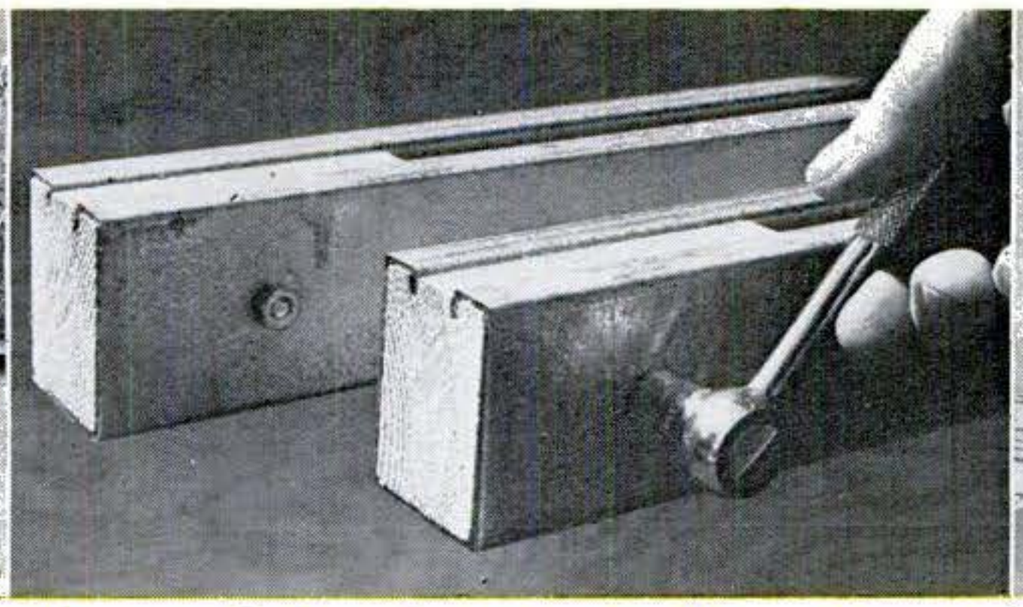


Construction is simple matter of butting 4-by-4s into two frames, securing joints with lag screws, and joining frames at top with three crossbeams, inserting wedges beneath them to splay frames. Bracing cables have turnbuckles for tensioning to keep frames square. Strap braces on ends are attached after unit is set up in yard.

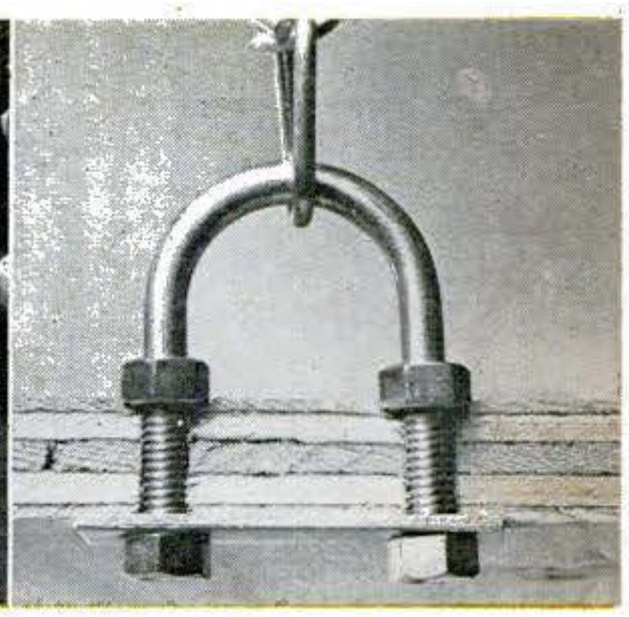
Once first frame is square, assemble second on top so they're duplicates. A single lag screw, wrenched snug, should do for each corner. Bore for cable eyebolts next.



Good ball-bearing hardware is essential to zoom action. Put a few drops of heavy oil on bearings before inserting. Unit is adapted with an eyebolt and S-hook.



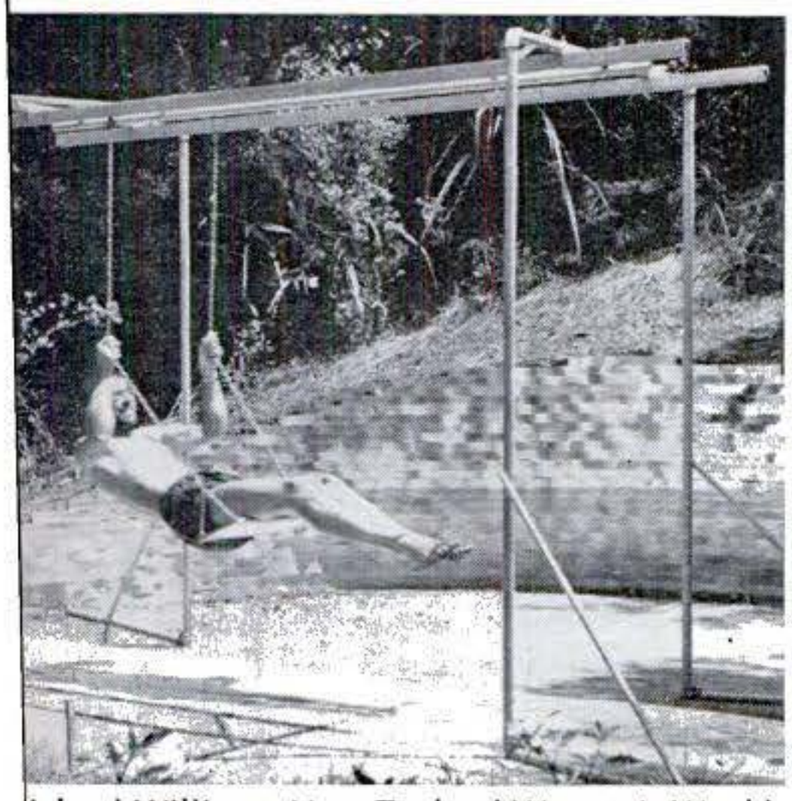
Each end of both tracks is closed with a wooden block shaped and double-kerfed for slip fit. Lock in block with ¼" bolt through track—removable to service hanger.



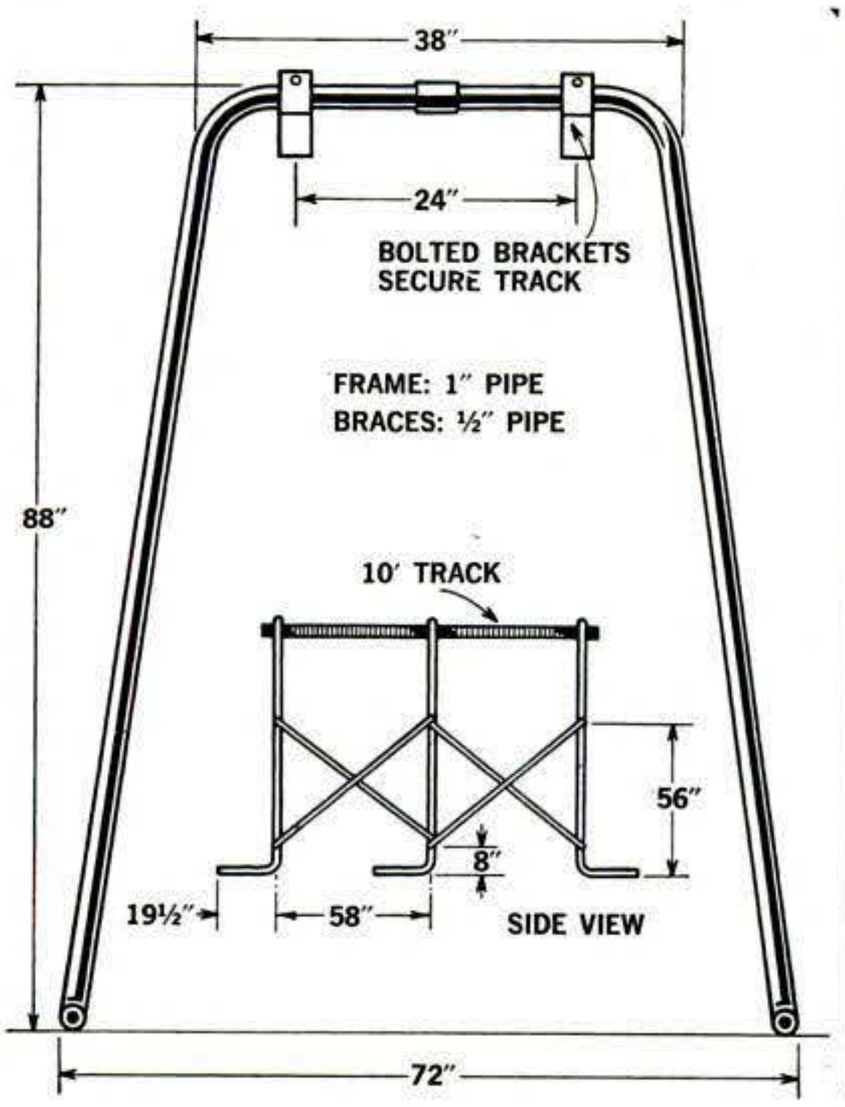
Cutaway of seat shows the easiest way to attach swing chain. Run extra nuts up U-bolt as far as you can, clamp seat against them with flange that comes with bolt.

Original versions from Down Under were constructed of pipe

Designer Forbes is shown testing an early prototype frame assembled with threaded elbows. Larger version in sketch and photo at right is shaped in a pipe bender from 10' lengths, joined in pairs with center couplings. Track length in both models is 10', but could be easily extended.



ichael Willison, New Zealand Woman's Weekly



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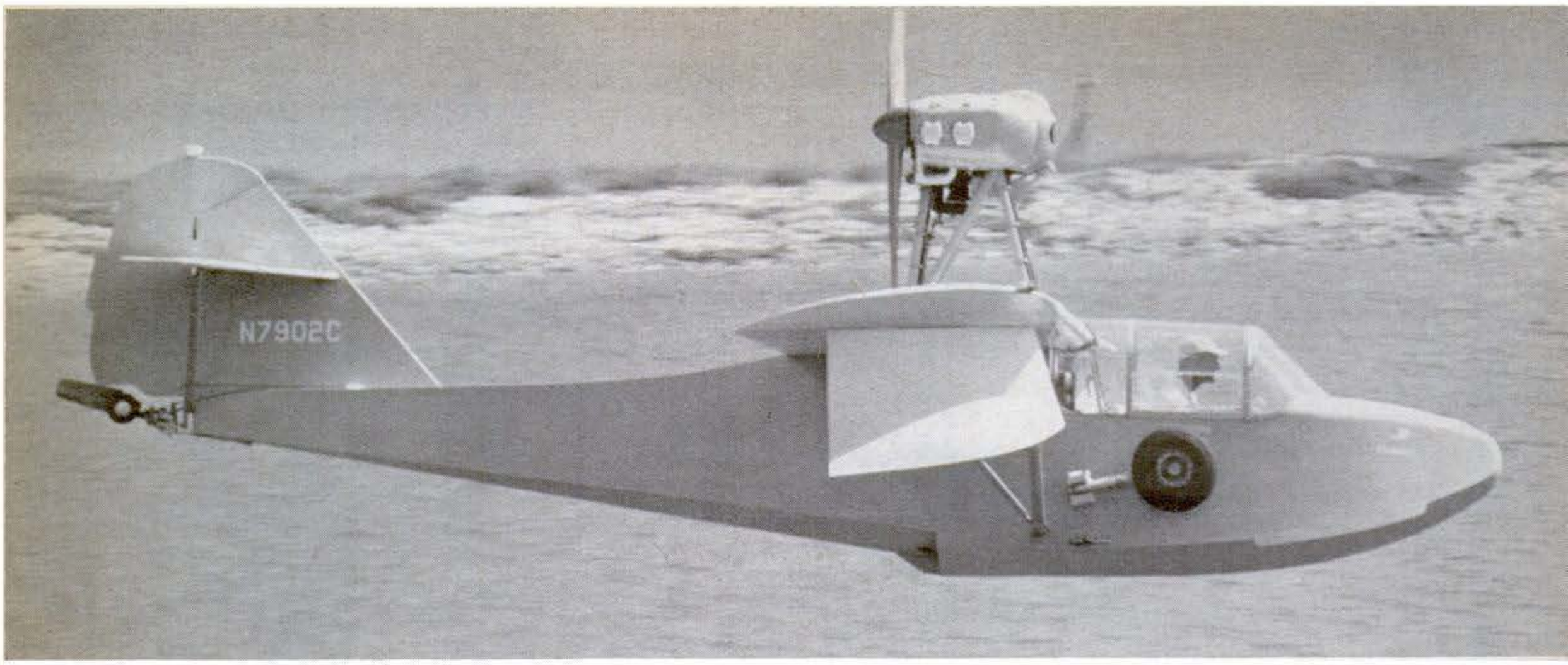
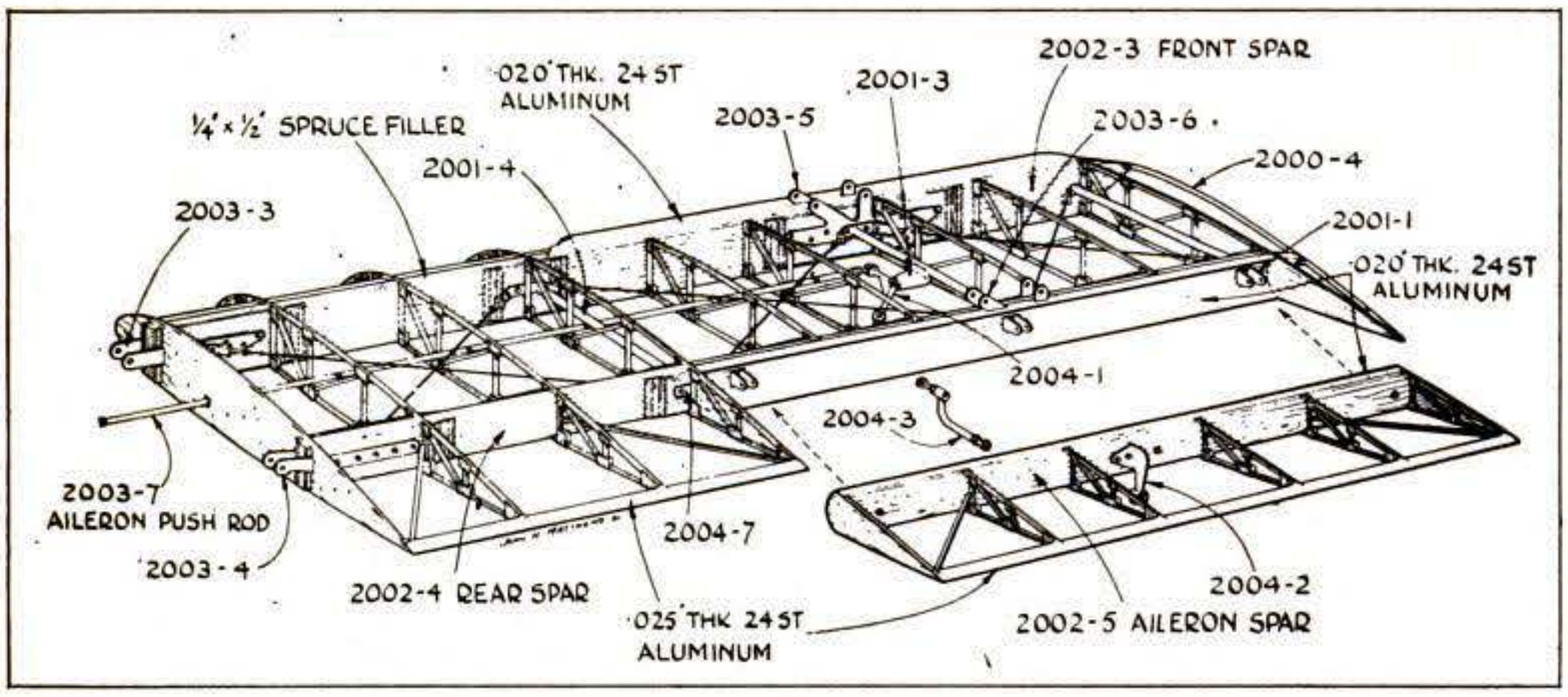


Volmer Sportsman Amphibian has fiberglass-covered air frame, mahogany-plywood and spruce hull, and manually retractable landing gear. Its useful payload is 500 pounds.

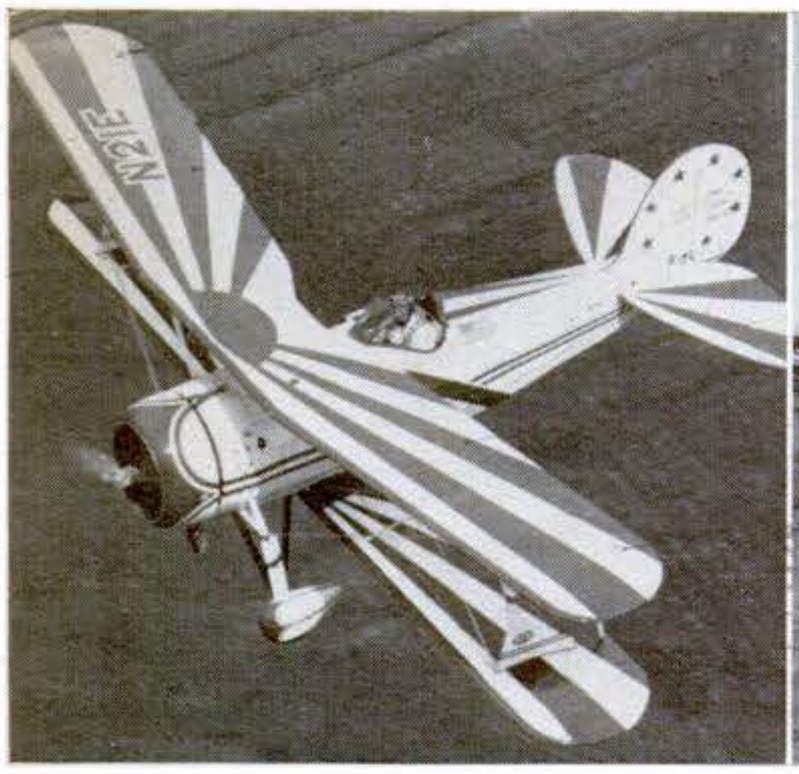
PS PRIVATE FLYING

All Those Planes You Can Build

Want an amphibian, aerobatic biplane, cross-country high-wing, sportster, replica, or gyrocopter? You can buy the plans and build yourself one for $1,000 to $4,000.



Detail of lower wing plans (above) are for the Experimental Aircraft Assn.'s biplane.



Most famous Great Lakes Sport Trainer belongs to aerobatic champ Harold Krier. Original model has been modernized.

"Sky Birdy," by EAAer S. A. Helfferich, shows a growing interest in whirlybirds by home-built-aircraft enthusiasts.

SOURCE
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Bob Bushby, Bushby Aircraft, 848 Westwood Dr., Glenwood, Ill. 60425
John W. Dyke, 2840 O. Yellow Springs Rd. Fairborn, O. 45324
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Experimental Aircraft Assn. P.O. Box 229, Hales Corners, Wis. 53130
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Dorothy Smith, 1938 Jacaranda Pl., Fullerton, Calif. 92633
M. B. Taylor, P.O. Box 1171 Longview, Wash. 98632
Volksplane Aircraft P.O. Box 744, La Jolla, Calif. 92037
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Volmer Jensen, Volmer Aircraft 104 E. Providencia, Burbank, Calif. 91502
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W. S. Evan's WE-1 Volksplane uses a converted VW auto engine. Simple wood frame needs only prop and magneto to fly.

1962 EAS-EAA design winner, P. Bowers' "Fly Baby" can be built as a low-wing mono- or bi-plane, uses pontoons or wheels.

Joe Hruby's "Cayuse" is a sleek, modern-looking monoplane powered by a 100-hp engine. It cruises the skyways at 125 mph.

EAA Outstanding Design winner, E. L. Turner built the T-40 of wood. It has folding wings and a laminar-flow airfoil.

from Plans

By THOM HOOK

How many homebuilt craft, would you guess, are flying the skies today? In fact, their number equals that of America's operational airliner fleet. The FAA in Oklahoma City registered 2,892 as of last August. Each year, 300 more join the fleet.

Hotbeds of interest are California, Ohio, and other states in the Midwest, in that order. But throughout the nation, in Canada, and overseas are 330 chapters of the Experimental Aircraft Association—one near enough for anyone to join.

A sign of growth is the week-long International EAA Sport Aviation

NAME/MODEL	CONFIGURATION	ENGINE	SEATS	MPH (CRUISING)	RANGE (MI.)	CONST. COST (AV.)	PLANS COST	PLANS PAGES	PLANS PAGE SIZE	APPROX. # PLANS SOLD (AUG. '69)	INFORMATION BROCHURE
Fly-Baby One	Low-wing (folding wings optional)	65/85-hp Continental	1	105/115	300	$1,260	$ 15	200	8½" x 11"	2,164	$1
Mustang MM-1	Low-wing	125-hp Lycoming	1	200	400	$2,685	$ 75	60	NA	350	both for $2
Midget Mustang Mark II	Low-wing	160-hp Lycoming	2	180	500	NA	$125	35	NA	650	
Dyke Delta JD-2	Low-wing delta (folding wings optional)	180-hp Lycoming	4	170	700	NA	$125	28 1	24" x 30" 24" x 36"	92	$3
Cougar	High-wing (folding wings optional)	85/125-hp Lycoming or Continental	2	140/150	400	$2,200	$ 20	12	NA	500	25¢
EAA Biplane P Series	Biplane	C-85 85-hp Continental	1	110	200	$1,900	$ 20	17	2' x 3'	2,000	free
Teal Amphibian	High-wing	115-hp Lycoming	2	125	450	$3,400	$100	28	2' x 3'	200	$3
Sirocco	Low-wing	105-hp Lycoming	2	124	570	NA	$100	50	8½" x 11" to 2' x 3'	210	$3
Mustang MJ-7	Low-wing	200-hp Fairchild Ranger	1	140	NA	NA	$ 90	100	NA	NA	$3
Baby Gt. Lakes	Biplane	A-80 80-hp Continental	1	118	250	$3,000+ engine	$ 50	19	NA	200	$2
Gt. Lakes Trainer	Biplane	150/165-hp Ranger or Continental	2	125	360	$3,500	$150	200 50	8½" x 11" 3' x 6'	130	$3 (both $4)
Pitts Special	Biplane	125-hp Lycoming	1	130	350	$2,575	$100	10	30" x 42"	1,500	$3
Breezy RLU-1	Parasol	90-hp Continental	2	75	250	$3,650	$ 25	15	18" x 24"	200	$1.50
Smith Miniplane DSA-1	Biplane	100-hp Lycoming	1	117	360	$1,855	$ 25	33	NA	415	$1
Coot Model A	Mid-wing, single-boom	145-hp Continental	2	110/120	500	$3,500	$150	200 12	8½" x 11" 18" x 24"	NA	$25 (100 4 x 5 photos) OR $3 packet
Coot Model B	Twin-boom tail		2							NA	
Volksplane WE-1	Low-wing	1200/1600 VW 40-bhp VW	1	70	250	$1,000	$ 35	73	11" x 17"	NA	$2.50
Turner T-40	Low-wing	85-hp Continental	1	145	450	NA	$ 65	18	2' x 3'	NA	$3
Sportsman Amphibian VJ-22	High-wing	85/100-hp Continental	2	85	300	$3,890	$125	17	250-sq.-ft. Blueprints	600	$2
Wittman Tailwind W-8	High-wing	85/140-hp Continental or Lycoming	2	150	600	$2,760	$125	20 26	17½" x 23"	328	$1

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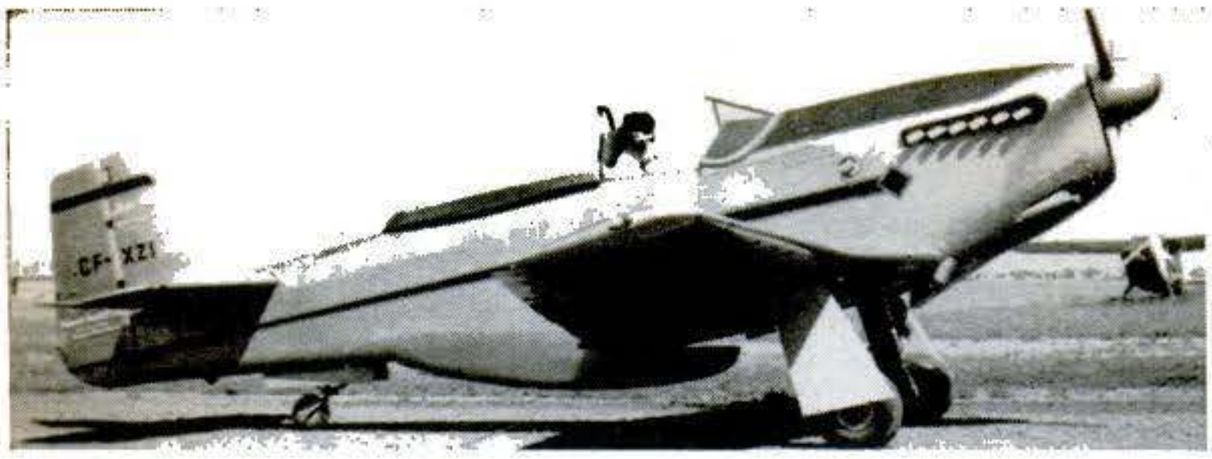
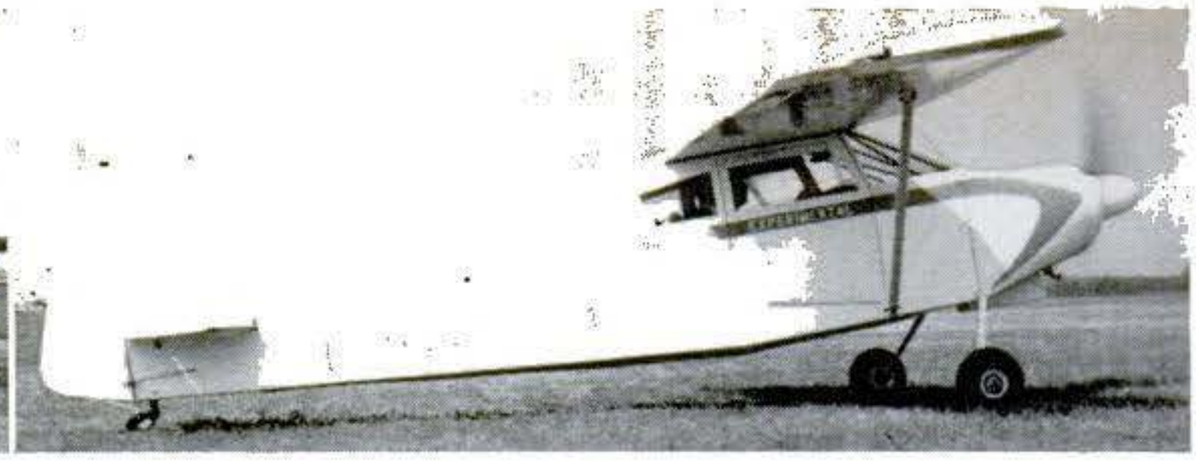
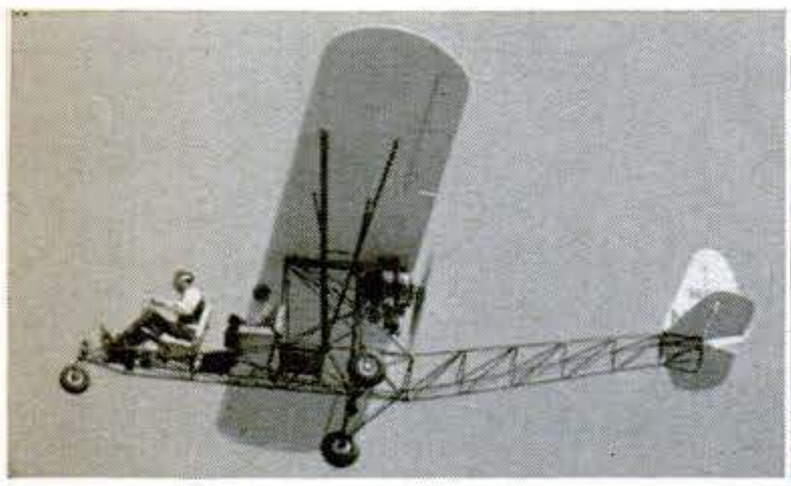


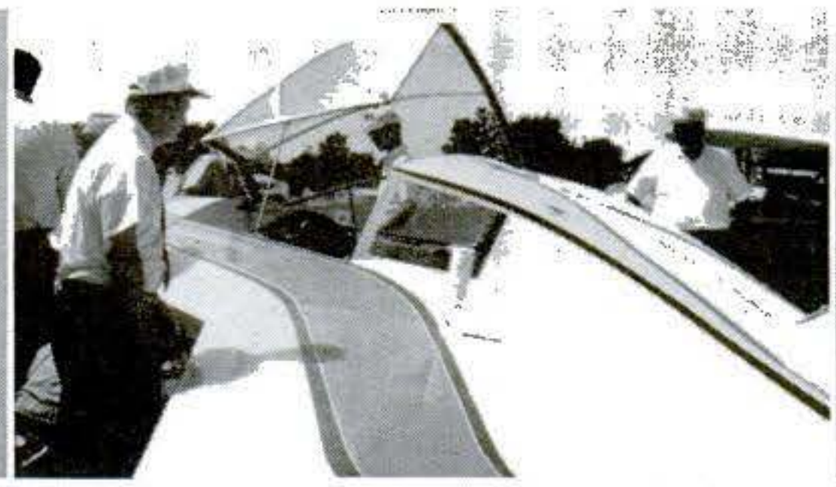
Most realistic P-51 replica, Marcel Jurca's MJ-7, is powered by a 200-hp Ranger engine. Prototype has 50 flying hours on it so far.



Folding-wing Cougar I by Charles Goodrich cruises at 140 mph. An economical side-by-side homebuilt, its plans sell for $20.



Strictly a fun plane, "Breezy" is a two-place parasol craft designed by C. B. Roloff. Its flying range—about 140 miles.



Fiberglass-covered Dyke Delta JD-2 has steel-tubed fuselage, wing spars, and tail. A four-seater, it cruises at 170 mph.

Speed breakthrough for two-seater is Taylor's Coot Amphibian model B with twin-boom tail. Model A has a single boom.

Convention and Exhibition held each summer at Greater Rockford Airport, 80 miles northwest of Chicago. Some 600,000 visitors now attend annually —nearly 4,000 by private aircraft—to admire the display of homebuilts, antiques, and World War II war planes. Conventioneers attend lectures and forums, see films, and rub elbows with successful homebuilders. Air traffic during the convention flybys peaked safely one day at 10,007 movements —double that of O'Hare and Kennedy International.

A plethora of plans. Many kinds of airplanes can be built from plans. The latest *EAA Directory for the Homebuilder* ($2.50 from EAA, P.O. Box 228, Hales Corners, Wis. 53130) pictures more than a hundred different fixed-wing, powered planes and, for the specialists, more than 30 gliders, gyrogliders, sailplanes, and a true helicopter.

Plenty of help is available, too. EAA chapter meetings offer members a chance to pool their diversified information. However, each buyer signs an agreement with the designer to build only one plane per set of plans.

Chapters also can get into the economies of group purchasing to lower costs, particularly for aluminum.

Time-saving aircraft part kits are advertised in all the magazines catering to the homebuilder. But you should not dream of buying parts you can bolt together to form a ready-to-fly plane. A basic rule set by the Federal Aviation Administration for earning an "Experimental" certificate is that at least half the work on the plane must be fabricated and assembled by someone undertaking the project solely for personal education or recreation.

Inspection required. After buying plans, the prospective builder visits the local FAA General Aviation District Office (GADO), which provides advisory circular AC 20-27A, "Certification and Operation of Amateur-built Aircraft." (Or he can get a free copy from the Dept. of Transportation, FAA, TAD 484.3 Distribution Unit, Washington, D.C. 20590.)

Components and instrumentation are left to the builder's discretion, but it is wise to use federally approved materials of aircraft quality. Normally, your aircraft needs an FAA inspection before you cover it and again before your test flight.

In between, the Experimental Aircraft Assn. has one of some 250 designer examiners who will look at your project and point out substandard workmanship that should be corrected before FAA inspection. The examiner will also urge you to file all receipts and invoices covering purchases, as proof of material used.

Before the test flight, engine tests are run following the particular manufacturer's recommendations. Fuel-flow testing is done without the engine running, but it must be tilted upward 45 degrees to determine if you will get fuel while climbing, banking, and the like.

"Must" guides showing how to complete basic forms are illustrated in the 62-page *EAA Aircraft Builders Handbook* ($2) and in the latest *Data Book for the Aircraft Homebuilder* ($2.50 from EAA). They

[Continued on page 116]

How long does a homebuilt take?

To build an amphibian requires patience more than any other quality. Russell Fatzinger, 55, of Baltimore, spent 973 man-hours building his first Volmer Sportsman five years ago. He has logged 1,000 hours on it since then. Now he is modifying a second Volmer.

For his first job, he bought Sitka seasoned spruce from a nearby lumberyard. A time-saver for all Volmer builders is the Aeronca wing. It costs $500 new, but only $250 used.

Excluding some outside professional welding, Fatzinger's first plane involved 973 man-hours, split up as follows: building the frame, 306; landing gear, 48; buying and attaching Aeronca 7-AC wings, and hooking up control cables, 354; fitting and painting the canopy, 65; installing brakes, wheel work, covering tail empennage, repairing wing tips, 78; work on used 85-hp Continental engine, 39; installing the engine, 71; and the simpler welding, 12.

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built heavier and tougher than it really has to be

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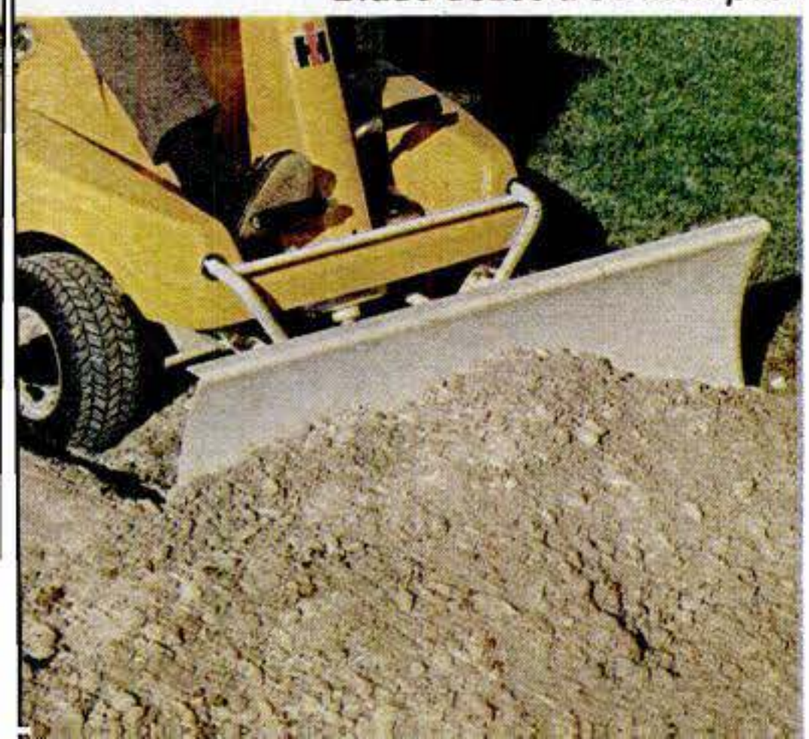
Complete line of attachments available: snow thrower; landscaping or snow blade; lawn sweeper and many more. Your International Harvester dealer is in the Yellow Pages under "Lawn Mowers" or "Tractors."

Blade dozes a 36-inch path



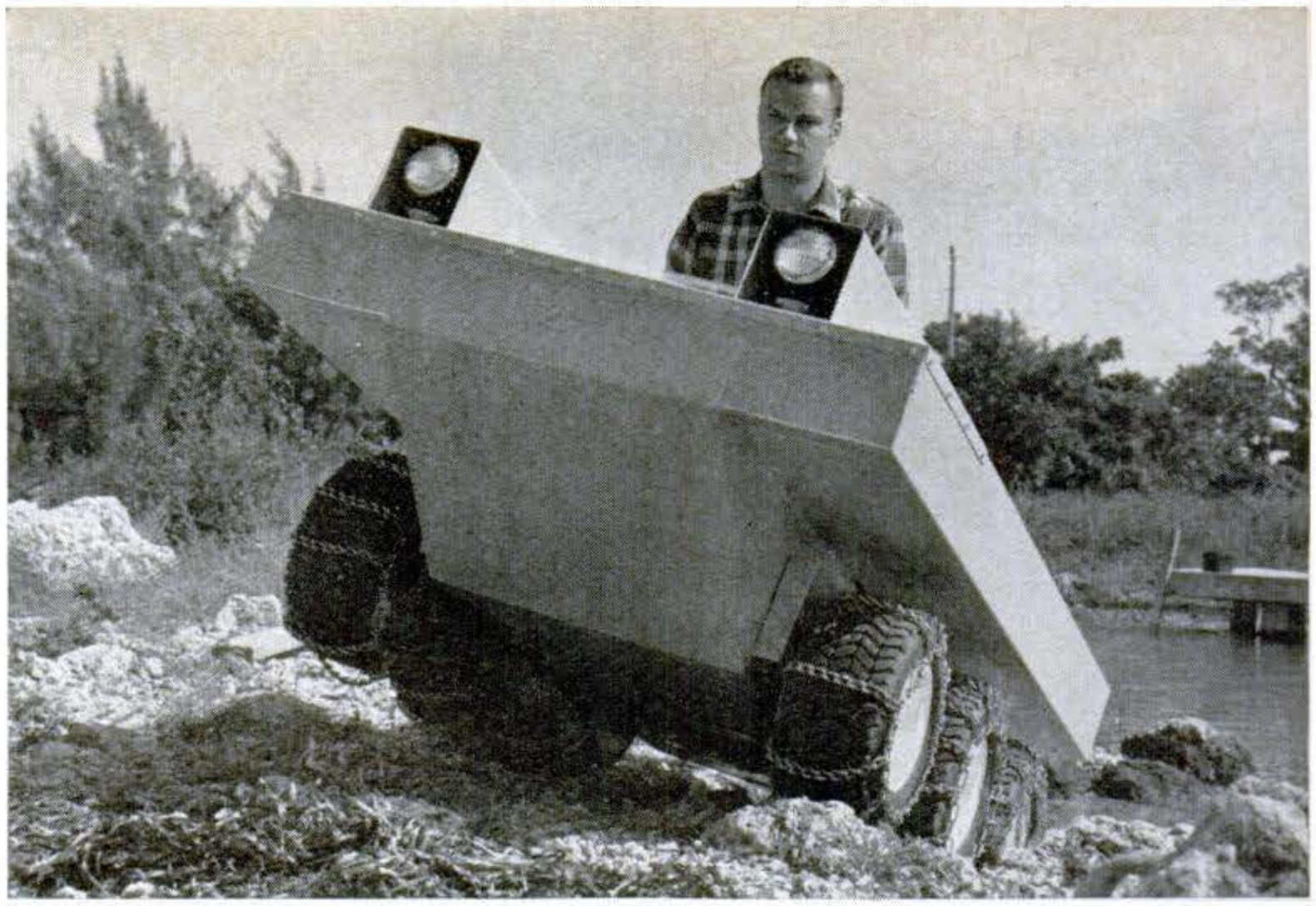
Snow thrower clears a 32-inch lane

Dump trailer—3½-bushel capacity

The ATV You Make from a Kit

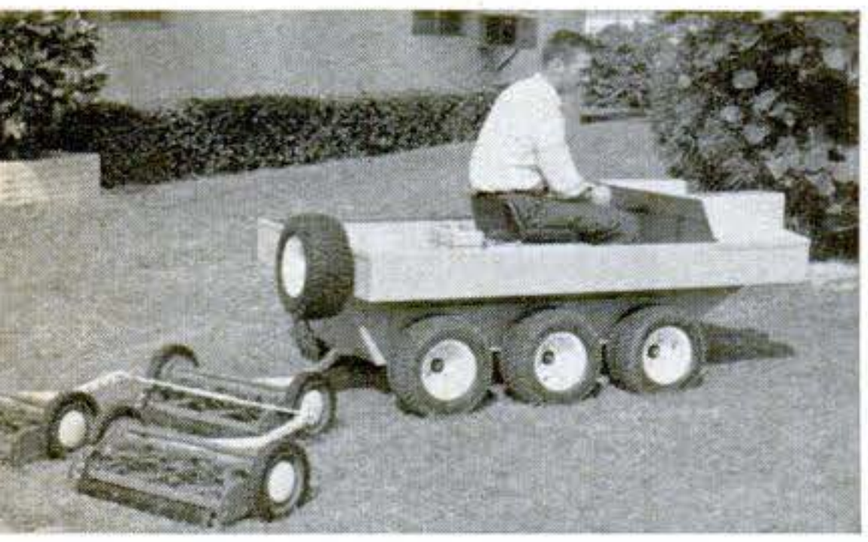
Everything you need for all-terrain fun—just bolt it together

By E. F. LINDSLEY
PS Outdoor Power Equipment Editor

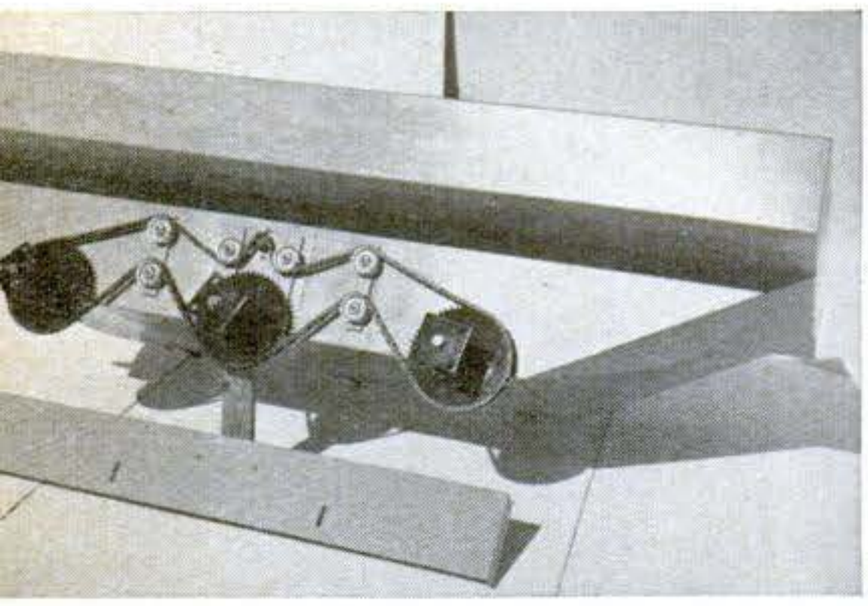


Mini-Scat can scramble up 45-degree hills on its 7½-inch tires. Chains are optional.

Complete kit includes pre-welded steel body, tires, drive mechanism, seven-hp engine, and dual control sticks.



Mini-Scat doubles as a helper around the yard. Attachments include gang mower, sweeper, roller, dozer blade, and trailer.

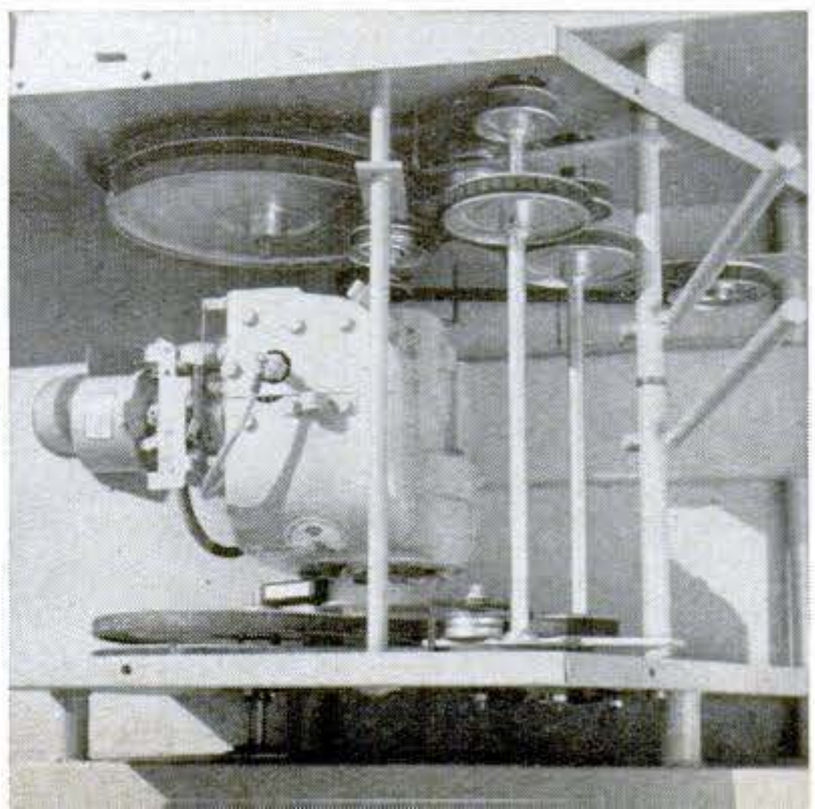


Exposed chains (above) restrict use in deep sand and mud. Photo, right: engine and drive train. Big double pulleys turn chain sprockets; smaller ones on double jackshafts provide forward and reverse.

Remember C. F. Struck's remarkable Mini-Dozer kit [PS, May '67]? Well, now he's come out with the Mini-Scat, an assemble-from-the-kit ATV. And unlike other ATVs, it has a utilitarian side. With low-gear capability and an assortment of attachments, it doubles as a garden tractor.

It's only fair to point out that the Mini-Scat won't give you the high-speed, skyrocketing leaps and wild performance typical of high-powered ATVs. It's not that kind of machine. The four-stroke, seven-horse engine gives you a safe and comfortable ride. Struck's ATV goes forward steadily—up to 10 mph—backs up, climbs 45-degree hills, and turns in its own shadow. Moreover, set up for 2½-mph tractor operation, the solid-steel workhorse will bull garden equipment around your yard all day long. The six big, soft tires are kind to tender lawns.

If the sharp lines of the Mini-Scat seem functional, they are. The 14-gauge steel hull will last a lifetime. Joints are watertight, and the whole machine floats high and dry with 10 inches of freeboard. Optional freeboard extensions are available for extended water use, and the straight rear transom will take a small electric outboard.



The kit comes to you with all welding done. All you do is bolt parts together. Or you can buy just the plans—for $5, including layouts for a plywood hull. Drive-train parts are available on an individual basis. Any way you approach the Mini-Scat, it's a project that you'll find is loaded with built-in fun.

The control system works exactly the way your instincts say it should. Push both handles forward, you move forward. Pull both back, and you move back. To turn sharply, just push one and pull the other. Although the entire drive works on a system of belt-tightener clutches, the geometry is excellent and the response is smooth and efficient. Some far more expensive machines are not as good.

The drive line is simple to maintain. A single pulley on the engine shaft drives a double-surface belt. The belt wraps clockwise around one jackshaft pulley, counterclockwise around another. Thus, the jackshafts turn in opposite directions for forward and reverse. Each jackshaft has a pulley at each end to drive belts to the large pulleys, shaft-coupled to the sprockets that drive the chains on each side. Pushing either control lever forward or back tightens the forward or reverse belt on that side. Everything works fine.

Mini-Scat offers electrical options for starting, lights, and an electric outboard. Lawn and garden attachments are available. The basic kit (from the C. F. Struck Corp., Cedarburg, Wis. 53012) costs $498.95 with recoil-start engine.

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Beware of the dog.

It may bite.

Into your wallet. For a new transmission, perhaps. Or maybe a new engine.

From such grief, we'd like to spare you. By suggesting you seek out a Volkswagen dealer.

His selected used VWs and domestic cars have much better manners.

Before they go on the lot for sale, they go in the shop for inspection. Where everything you'd want to have checked out gets checked out.

(Things like cylinder compression. Clutch play. Brake system.)

If anything at all needs to be repaired or replaced, it gets repaired or replaced.

And only those thoroughbreds strong enough to pass this very thorough going-over get the Volkswagen dealer's 100% guarantee sign.*

Which tells you the one thing you need to know about a used car:

It won't bite.

*The dealer guarantees 100% to repair or replace the engine, transmission, rear axle, front axle assemblies, brake system and electrical system, for 30 days or 1000 miles, whichever comes first.

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The rule

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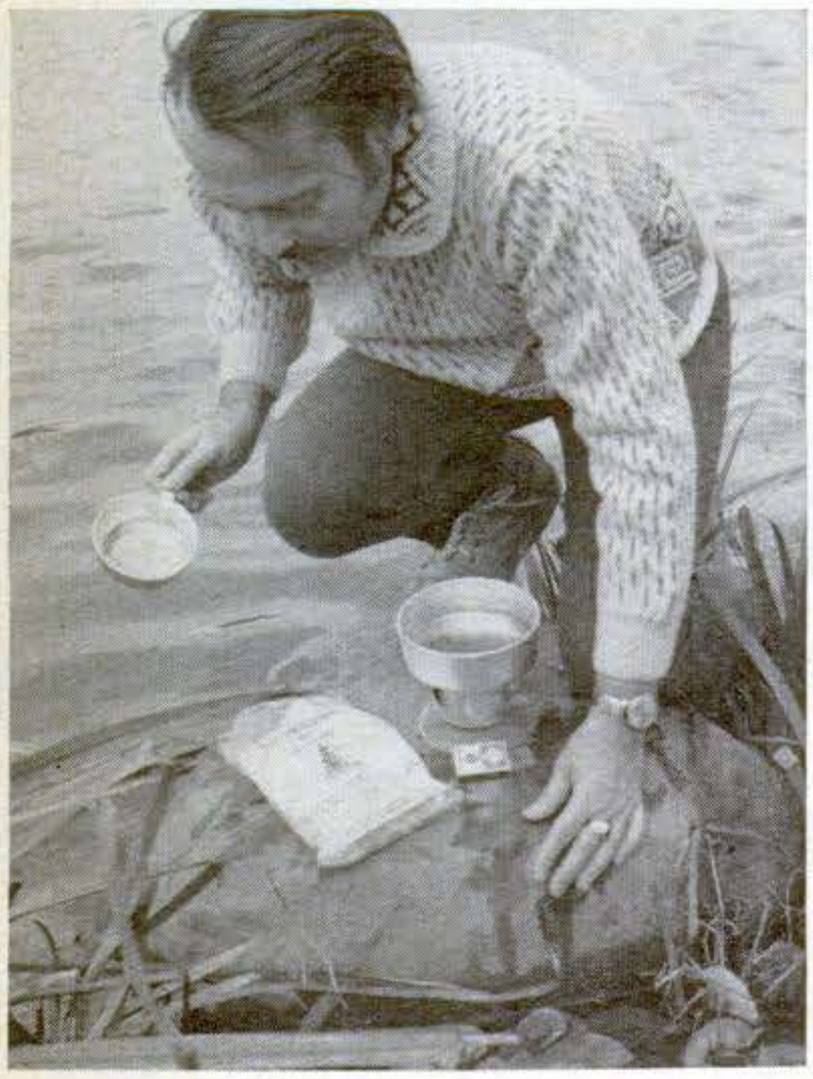
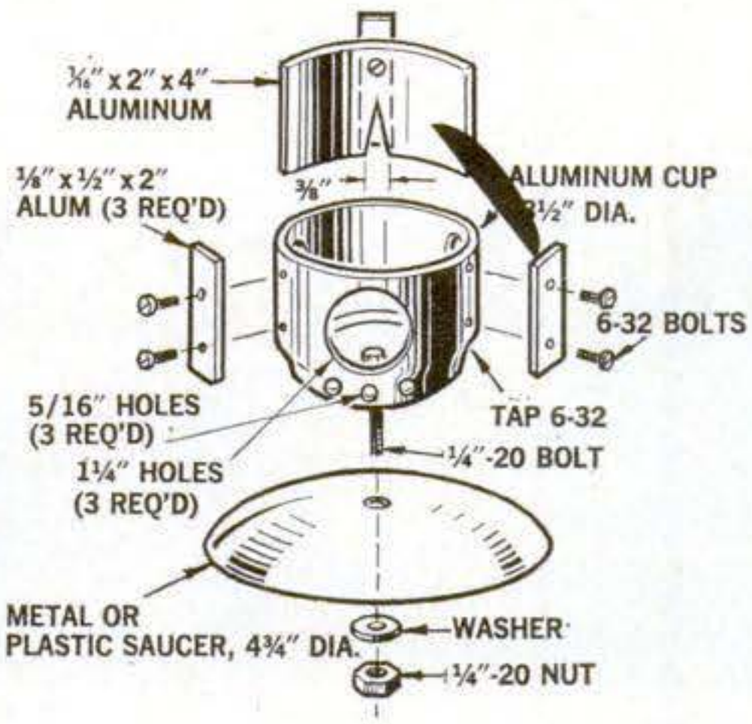
Trail Stove Shields Canned Heat from Wind

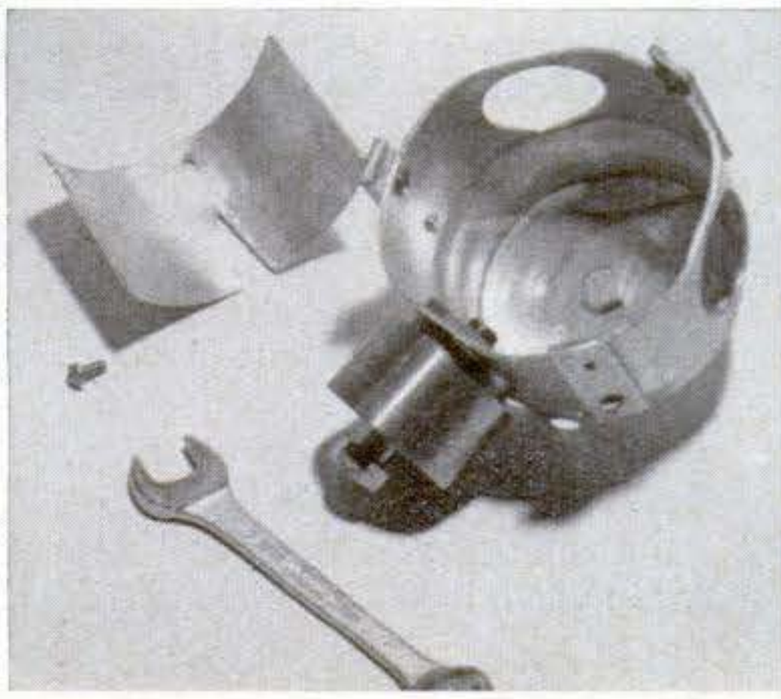




Canned heat—Sterno is the familiar brand—is the cleanest, safest, and most portable cooking fuel for backpackers. But there's no practical stove made for the small-size can—no stove you can use on uneven ground or without a big windscreen.

Make this lightweight model and you can set up your kitchen anywhere. Just turn the internal screen toward the wind and light up, as shown below. Stove and a can of fuel will pack inside a quart cook pot.

The nontip base is made by center-drilling a copper saucer bought in a crafts store.—*Norman Fallon*



Aluminum heat chamber (partly assembled at right) is modified drinking cup. Three big holes in side were made with the 1¼" radio socket (chassis) punch shown, borrowed from a ham operator. Alternate method: a hole saw in your drill press. Saucer base can be snugged into soil, far right.

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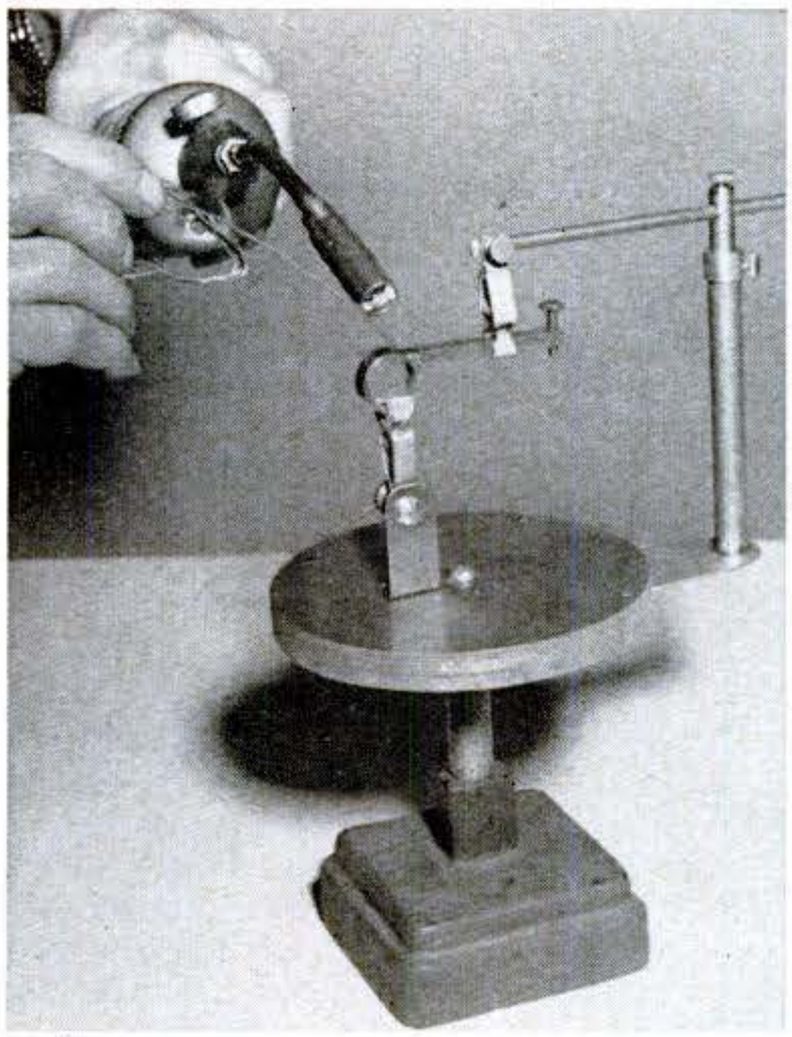
Simple Jig Holds Small Parts for Soldering

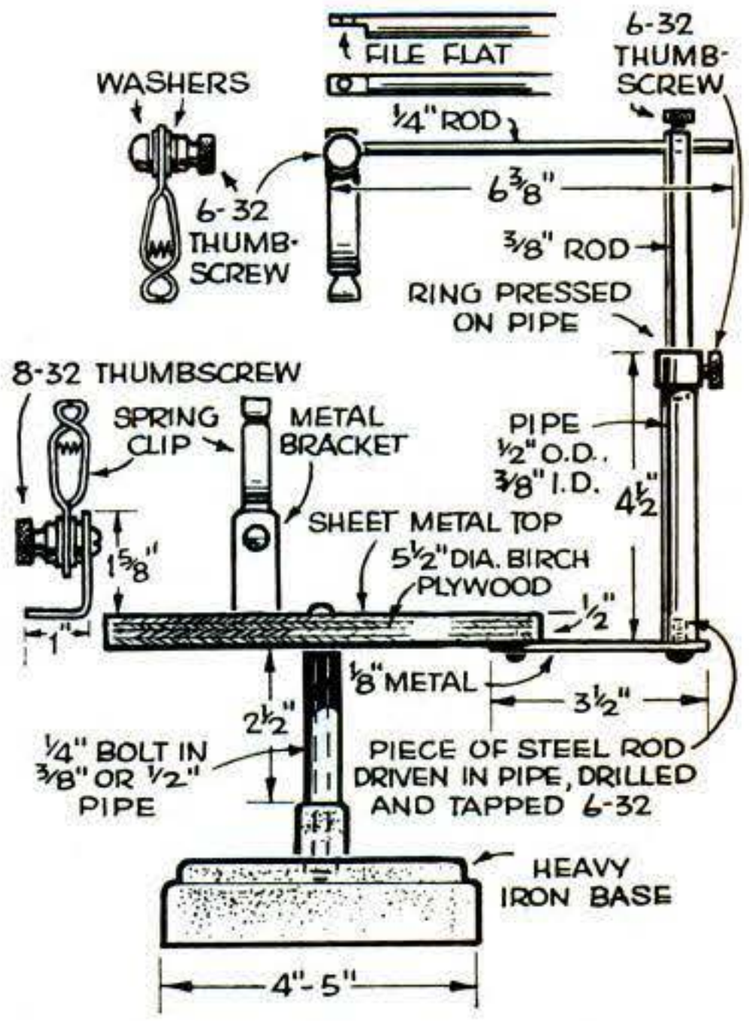
Easily built, this useful jig will prove invaluable in a metal-working shop for holding small parts and metal pieces which must be soldered or brazed. It will also keep pieces in position when you use epoxy cement or other adhesives.

The photo shows how the jig is used in a small soldering job, but there is virtually no end to the ways that you might be able to use it.

The cast-iron base was salvaged from an old piece of lab equipment I had on hand. Something similar can be used so long as it forms a solid support for the parts attached to the small, round worktable.

A spring clip is pivoted on a bracket which allows it to be used in either a vertical or horizontal position. One of the parts to be joined is held in this clip. The other is supported in a second clip attached to an adjustable arm which can be raised, lowered, or moved sidewise. Thumbscrews tighten up all joints and sliding members.





Because of this infinite adjustability of the two holding arms, parts to be joined can be arranged in any position you may want.

The worktable is a circular piece of birch plywood with a top face of sheet metal. The center support is a piece of pipe. A piece of ⅛" aluminum attached to the underside of the table supports the adjustable holding arm.—*Harold P. Strand*

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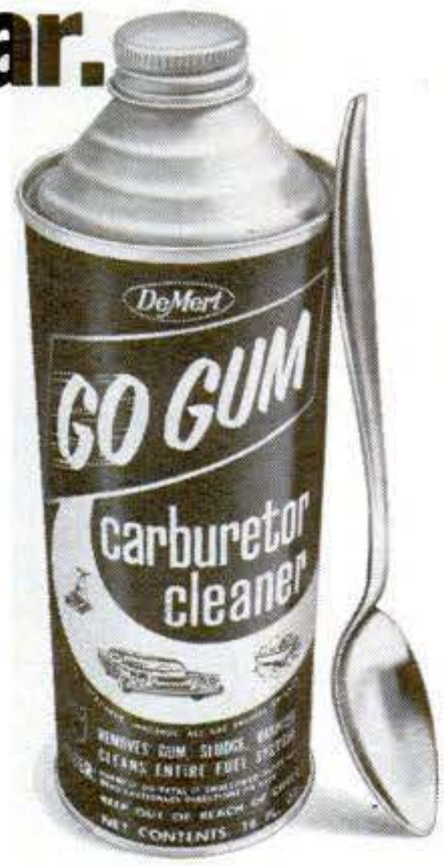
The laxative for your car.



Another dependable from DeMert

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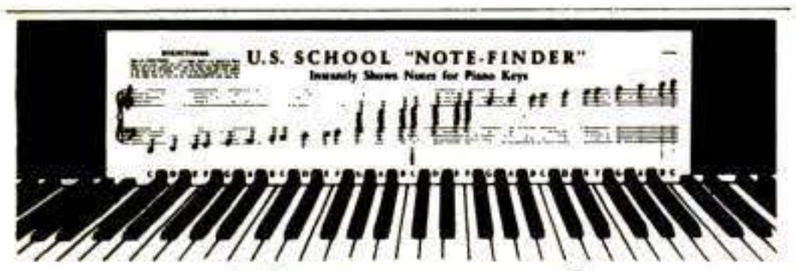

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SHOP TALK

By ROBERT P. STEVENSON

A couple of news notes about home-shop power tools

What would you consider "the perfect starter group for the home workshop" when it comes to stationary power tools? Rockwell makes what seems a very sensible combination in its current promotion—a 10" table saw with extension wing and stand, a radial drill press, and a 4" jointer. You could do a lot of fine work with a set of such tools . . . Black & Decker dealers now are offering a fine woodworking manual, *How to Get the Most Out of Your Radial Arm Saw* by Howard Silken, an expert in the use of this tool. You can also get the book by mail by sending $4.95 to Walter Stiffler, Black and Decker, Towson, Md. 21204.

Noncorrosive staples? They're available, if you hunt

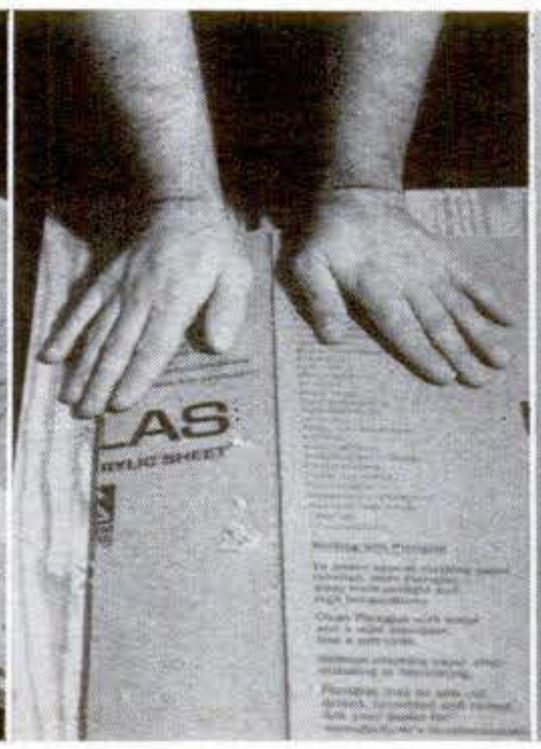
One reader writes that he settled for standard staples for applying new covers to his boat seats when he couldn't locate brass or copper staples. I put the problem to stapling-tool makers. Bostitch replied: "We manufacture stainless-steel and copper-alloy staples, popular with yachtsmen. These may be applied with our T5 tacker." Swingline also had a good answer: "We manufacture a Monel staple, a nickel alloy superior to copper and brass in rust and corrosion resistance." So if you need such staples, insist that your dealer order them.

Collection of 1,000 ancient tools now on display

Visiting New York City this summer? Make a note: Currently on display is one of the best collections we've seen of tools dating from medieval times up through our Colonial period. They're at the Hallmark Gallery (Fifth Ave. at 56th St.) and admission is free. Collector Aaron Rose scoured Europe and the U.S. for these tools for six years. He has now crowded himself out of his apartment, so he'll sell the collection when the exhibition closes, July 16. Before you enter a bid, be advised that he hopes to serve as consultant or curator to the buyer—preferably an organization that will keep the tools on display.

Special tool for scribing sheet plastic now a best seller

Would Plexiglas buyers also buy a special cutting tool? Our friends at Rohm and Haas debated this question some months ago while discussing the recent introduction of a variety of Plexiglas sheet materials for sale through hardware, building-supply, and glass dealers. It was decided to offer a penknife-like tool (below right) at a suggested price of $1.98. Word now comes that there have been many takers. You score smooth-surfaced acrylic sheet by pulling the tool several times along a straightedge (below left). You then snap the line over a dowel (center photo). The tool is not recommended for patterned Plexiglas. Can't find it locally? Check the yellow pages for an authorized Plexiglas dealer, or write Rohm and Haas, Independence Mall W., Philadelphia 19105. You may want their 25-cent project booklet, too.



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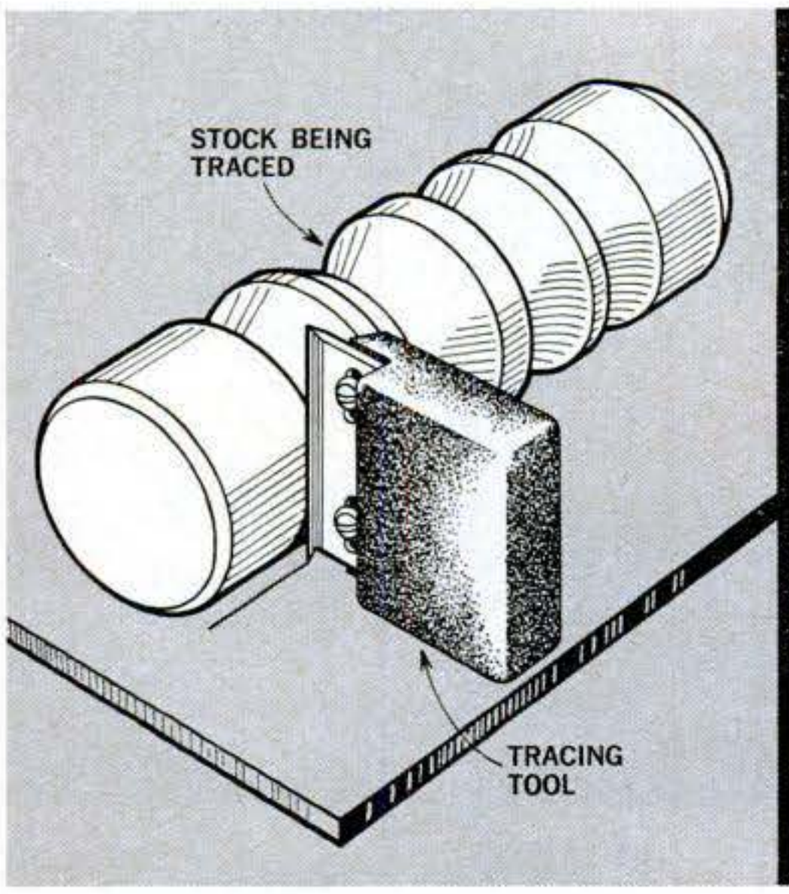
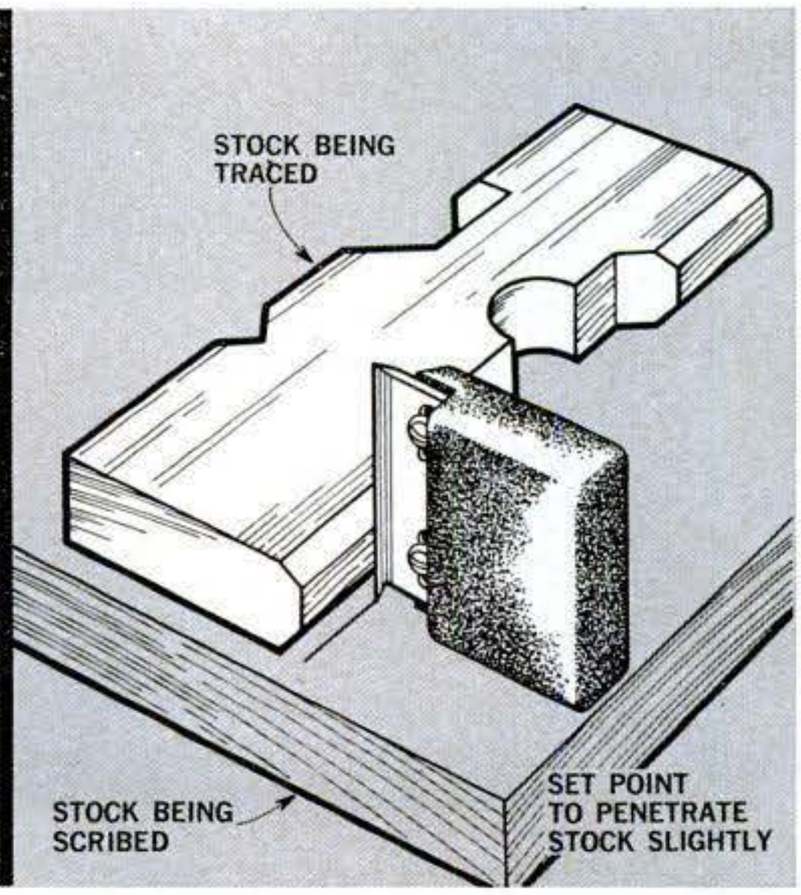
A Tool for Tracing Contoured Parts

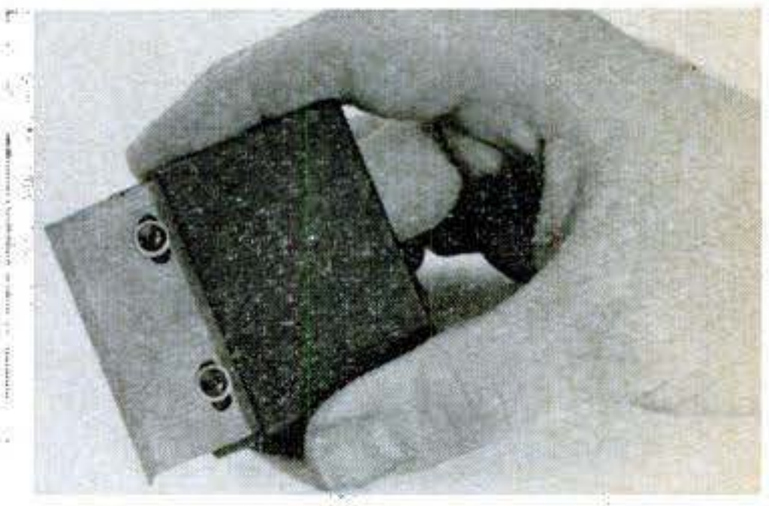
THIS tracing tool greatly simplifies the reproduction of parts with irregular contours. An ordinary scriber can't accurately trace parts with external chamfers or radii—the edges of the part lack a firm bearing surface for the scriber, and it can easily slip out of square. This tracing tool automatically maintains a square angle between the edge being traced and the stock being scribed. You get perfect tracings, even when making templates from turned stock, as shown below, left.—*Marvin E. Duchoviner*



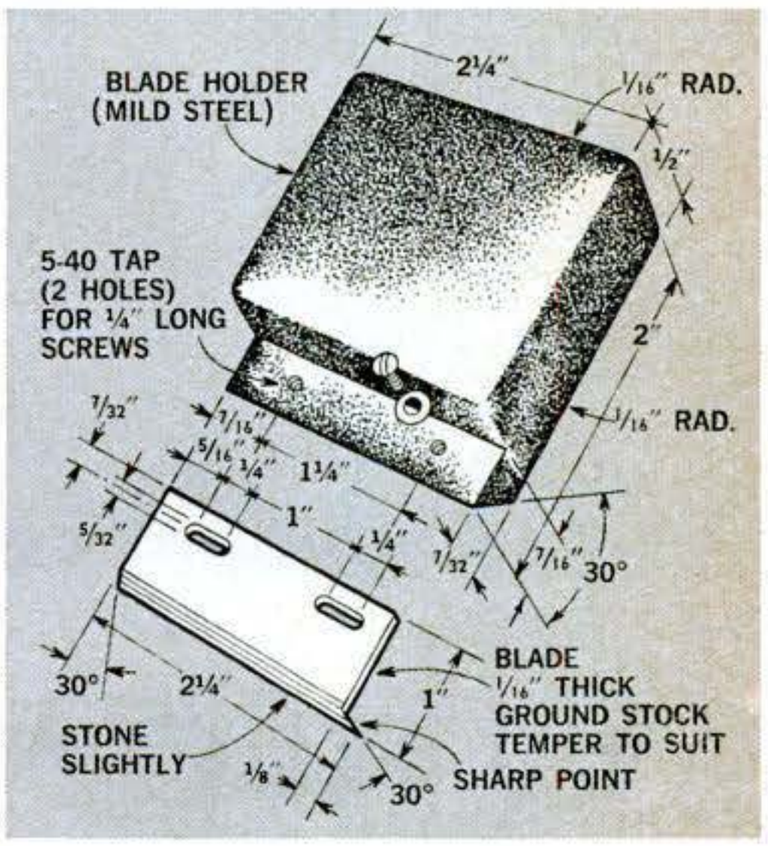
Tool will scribe the outline of a turned part onto stock to be used as a template for duplicates. Also, plan-view outline is easier to measure than the original turning.



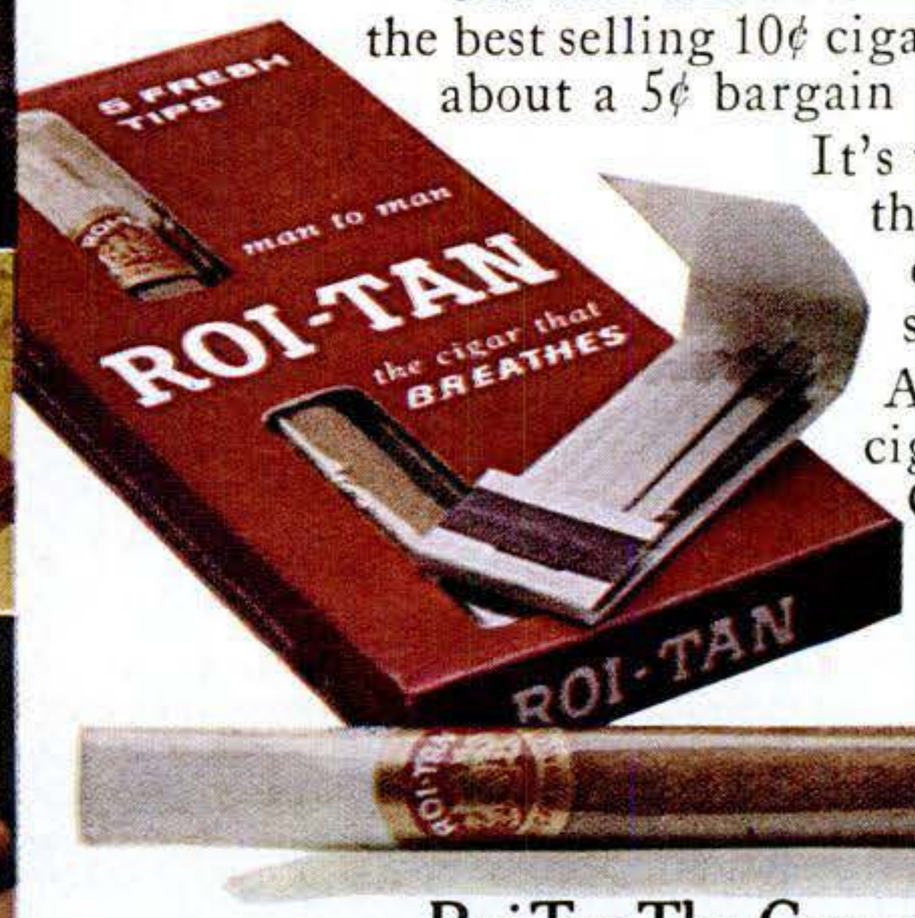
You can trace directly from original onto stock from which duplicate will be cut. When making many parts, cut, finish, and test the prototype, then trace in multiples.



You adjust blade with two machine screws so scribing point rides at the correct depth.



A 5¢ Bargain right under your nose.



Our full-sized Roi-Tan has such great taste it's the best selling 10¢ cigar. So now we'd like to tell you about a 5¢ bargain that tastes every bit as good.

It's the Roi-TanTip. It costs the same as a lot of other tipped cigars, but that's where the similarity ends.

And, we make two other 5¢ cigars, besides. Trumps and Cigarillos and a 4¢ cigar called Golfers. They all have that great Roi-Tan taste. And they all cost a nickel or less.

Roi-Tan The Crowd Pleaser.

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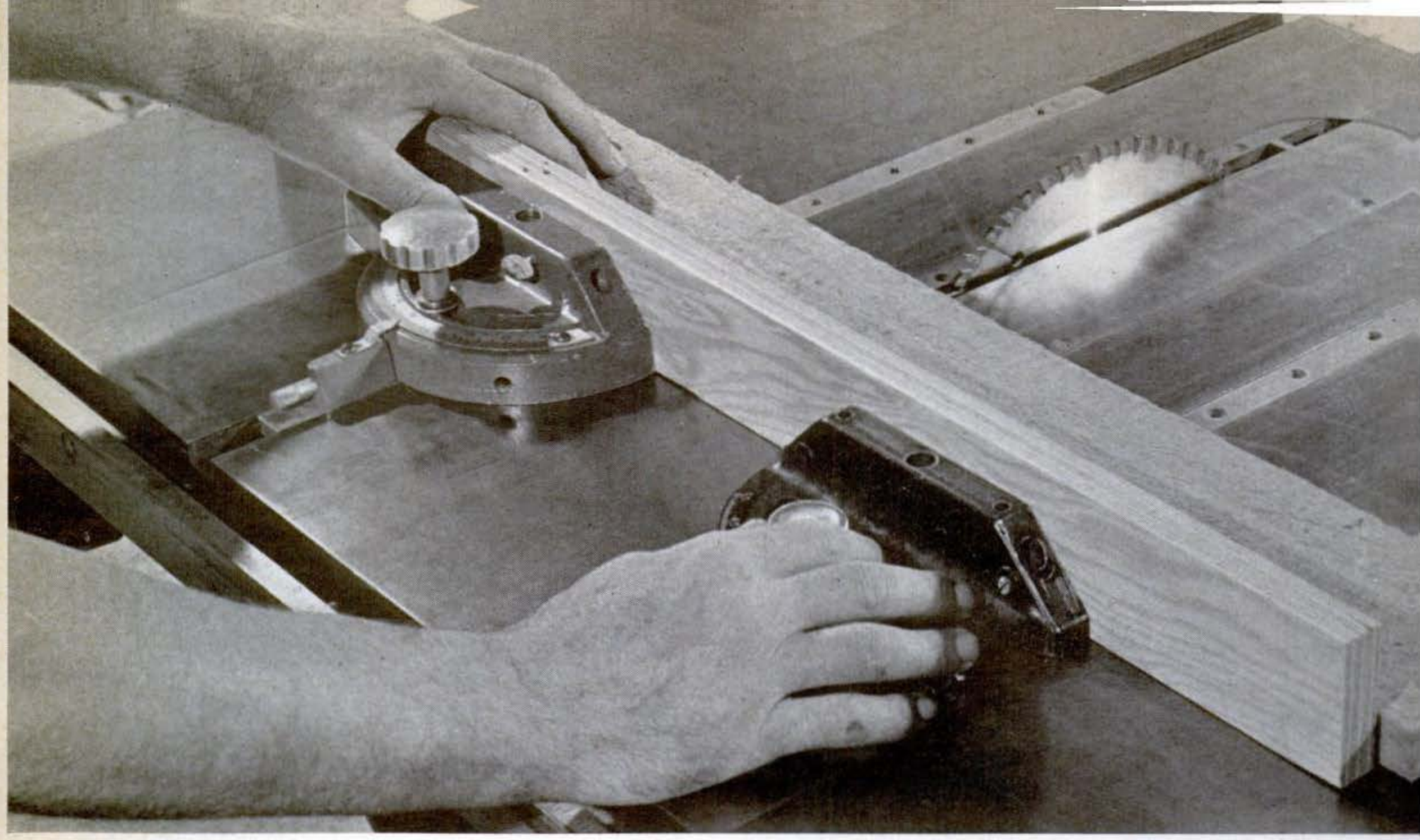


For crosscutting, yoke a pair of gauges with a fence—most gauges have holes for screw attachment. This is good for long pieces needing support on both sides of blade, and for pieces too short for gauge.

Why TWO Miter Gauges Are Better Than ONE

By R. J. DeCRISTOFORO

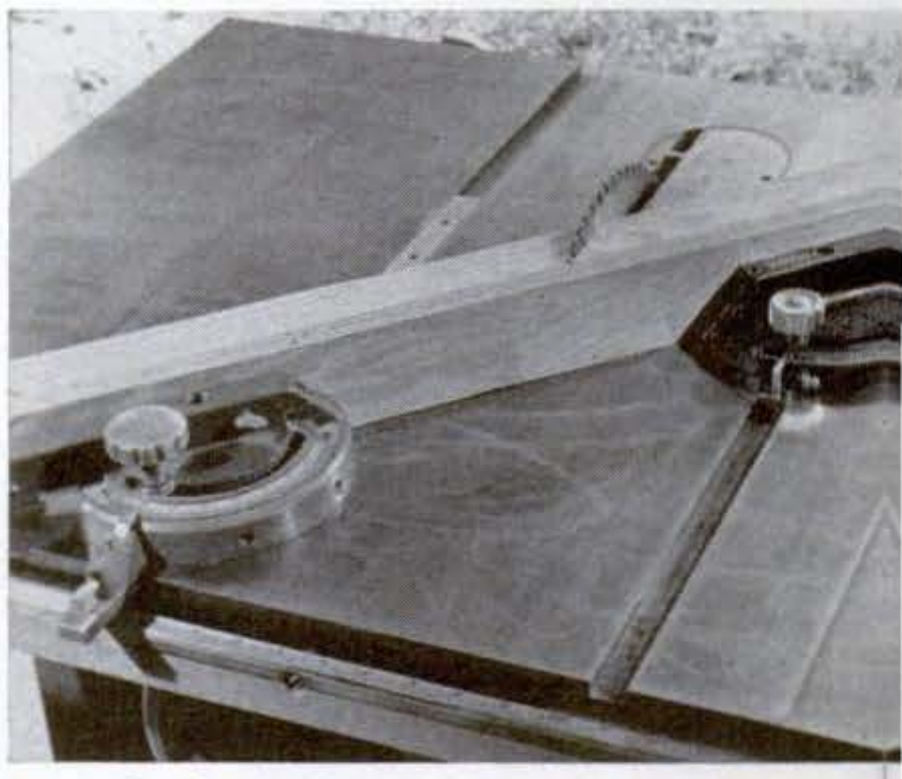
Having two miter gauges for a table saw is not the personal indulgence you might think. It merely goes along with a very wise thought: that everything done to make work more convenient and to minimize the chance of human error will help produce more accurate cuts—faster.

An example is miter-cutting that requires readjusting a single miter gauge to make mating cuts. This occurs when the stock is so shaped that it can't be flipped over.

Your second miter gauge need not be a duplicate of the one you already own. But be sure that the bar fits the table grooves.

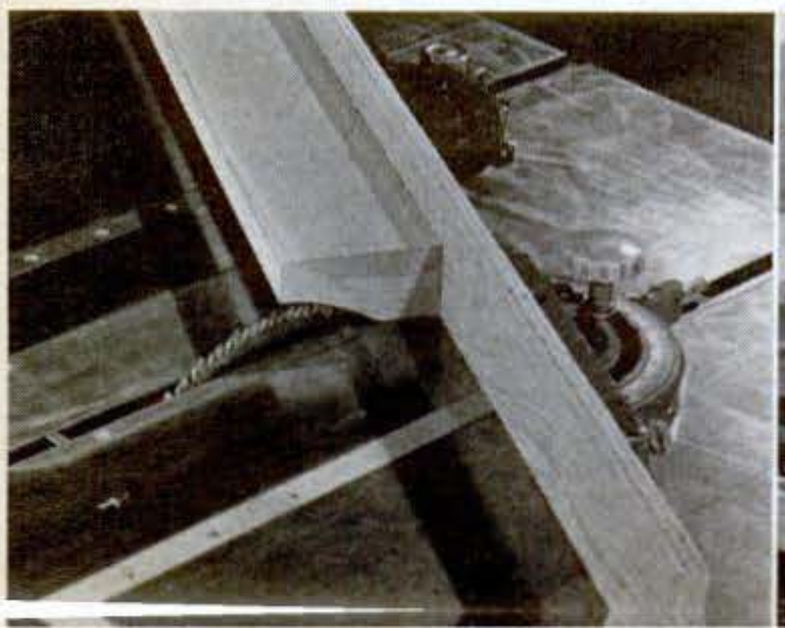
Since a miter gauge is an adjustable tool, you must learn to set whatever stops it has and to set them right. Take enough time, the first time you reset, to be positive. If you don't, you'll face the job anyway when you become aware of bad cuts on the good stock you've spoiled.

It's a good idea, too, whether you work with one miter gauge or two, to keep the table surface clean and waxed. Smooth-sliding tools increase both accuracy and safety.

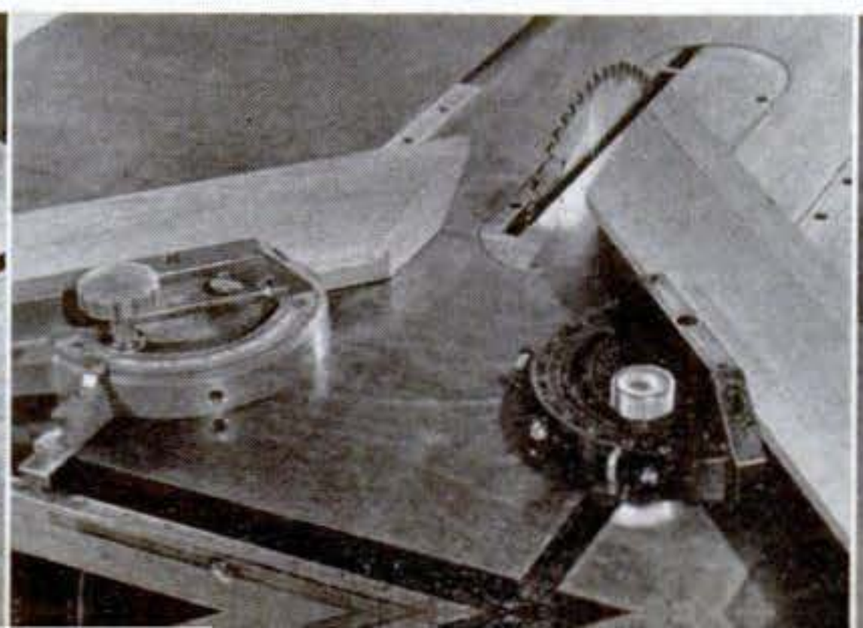


Reattached at angle, same fence is good for many miters—especially those on flat stock you can flip for mating cuts. Setup shown cuts down creep that ruins many miter cuts; the fence can be faced with sandpaper.

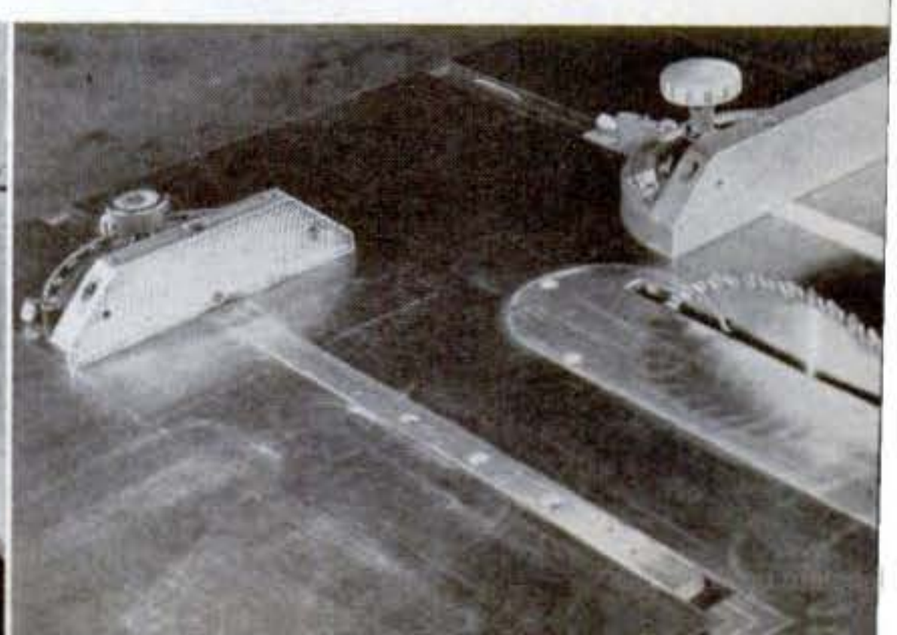
For cutting coves, yoked gauges provide best support. Since you can read the angle, note it down so you can create same setup if you need to duplicate the cove later.



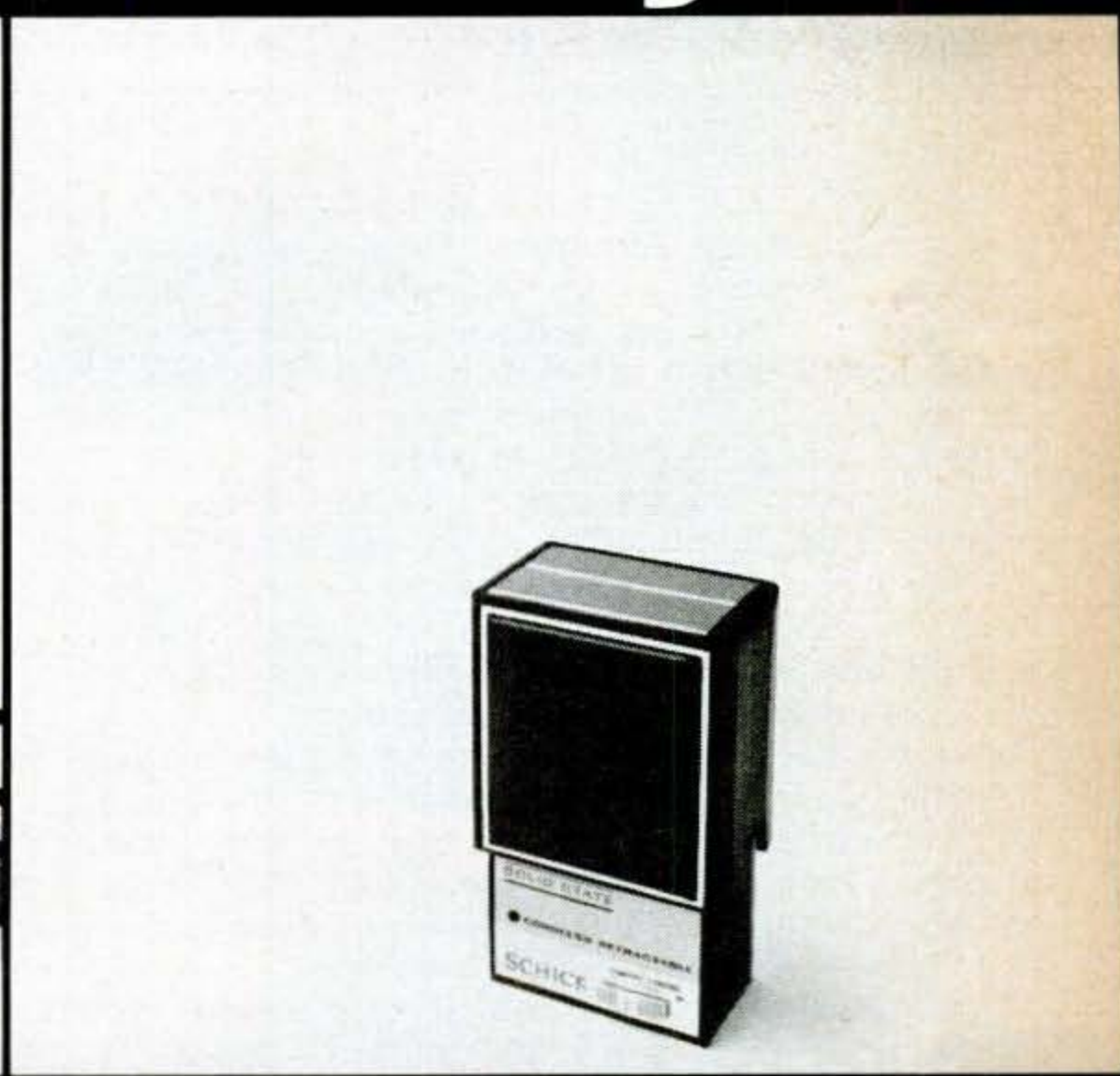
Stock can't be flipped? Set gauges to opposing sides of normal 90-degree setting. Use them as shown or in same table groove or backwards, depending on shape of stock.



Gauges needn't be twins to work well together, though bars must be identical to fit table grooves. But buy one at least as good as the one that came with the saw.



Schick's cordless shaver gives you less for your money.



Less to mess with
Less to store
Less to plug in
Less to break
Less to lose...

it's all built in.

The headguard, the transformer, the charger—the Schick Retractable has everything built in!

Forget to charge the batteries? Just plug this cordless directly into an outlet (with the single cord we give you)—and shave instantly!

Ordinary cordless shavers need extra stuff. But the Schick needs no extra protection, no extra power units. Solid State is why.

Solid state design. And a solid state controlled motor that powers self-sharpening chromium steel blades.

Nothing shaves closer and easier.

The Schick Retractables—you need a lot less, to shave a lot better.

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[Continued from page 51]

well-equipped model could top $3,000.

Key specifications of the car are: new four-cylinder OHC aluminum engine, 2,100 lbs. curb weight, four-passenger seating capacity, 97-inch wheelbase. Other mechanical features include front disk brakes and coil-spring suspension on all four wheels. Horsepower ratings will start at 95, going up to 140 ultimately, depending on carburetion.

Chevy claims the new car will "go as far on a quart of gas as some big cars do on a gallon." Translated, that means about 28 or 29 mpg—maybe even 30.

Ford's Pinto—the car with more code names than a master spy (Phoenix, Special Maverick, Pony)—has only one body style, a two-door sedan. In most respects, Pinto is similar to the small Chevy. It holds four passengers on two front bucket seats and a minimal-comfort bench rear seat. Its four-cylinder OHC cast-iron engine with 122-cu.-in. displacement is rated at a base 86 hp, but can be boosted to about 125 for high-performance models. Automatic transmission, air conditioning, and other extra-cost options are provided for in the layout of the car even if they are not initially offered when the car debuts in August. While Ford designers had one eye on the imports when they drew up the first Pinto, you can see the car is also built to compete strongly with the small Chevy.

But Pinto is markedly smaller than the Chevy: three inches in wheelbase and eight inches in overall length. Combine that with the smaller engine, and you come up with a car potentially more economical to operate. You can also expect the Pinto to sell for a trifle less than the small Chevy when prices are announced in September, giving Ford an added jump on its biggest competitor.

After the small cars, is there anything else new for 1971?

Definitely yes. Each of the companies has new body styles in at least one model line. Two new engines, the first four-wheel anti-skid system, more side-impact safety bars, and a drastic cut in the number of models offered round out the other highlights of the new cars. Most sweeping engine change, of course, is the switch to low-compression ratios on virtually all '71 power plants to accommodate lead-free fuel (see page 45).

General Motors. Three basic Fisher bodies are completely restyled—B, C, and E. These include all the full-size models and the personal/luxury group of Toronado, Eldorado, Riviera. All the other GM cars will get facelifts at most, while Camaro, Firebird, and Corvette will continue unchanged. Look for highly formal roof lines in the Cadillac, Olds 98, and Buick Electra 225. Rear windows will be small, "C" posts will be extra wide. Rear fenders on the Electra will be higher, verging on the point of being fins! Chevrolet, Buick, Pontiac, and Olds medium-price cars also will have a formal look in the four-door models, but the two-door body is sportier. Chevy has a sloping roof on one two-door with lots of glass at the rear, something like the 1959 models.

All GM full-size cars will get the double-thickness roof that was introduced on the 1970½ Camaro. It strengthens the rollover protection, adds to structural rigidity, and provides better sound isolation than present, single-sheet roofs.

Major styling changes can be seen in the Riviera. Its back window and trunk line is similar to Buick's of 20 years ago! Toronado will drop the sporty image in styling and engineering of its models, and concentrate on selling the car as a "luxury" automobile, emphasizing prestige. While Toronado will keep its front-drive system, the rear suspension will be changed over to coil springs instead of the leaf presently used. The new springs, spring seats, and axle trailing arms are the same as on the Olds 98.

Pontiac is preparing a luxurious new model to compete in the upper medium-price range of the market. Called the Grand Ville, the car will feature single headlights and a massive centered grille of egg-crate texture. Pontiac plans to replace the Bonneville with this car at the top end of its market.

Front disk brakes will be standard equipment on all full-size GM cars.

Ford. As at GM, the big Fords and Mercuries will be newly styled. Year by year, these cars seem to grow bigger, more luxurious, and 1971 will see this trend continued. The big cars will get hidden wipers, hidden antennas, and a new 400-cu.-in. engine. Formal roof styling is featured here, too. Two- and four-door models have an extra-wide "C" post and tiny back light that has a vertical crease precisely in the center. Door handles are pull-type. Inside, the instrument panel of the Ford is a dead ringer for the present Cadillac, with all the instruments inside a wide-winged section directly in front of the driver.

Lincoln Continental and Mark III are virtually unchanged, and Ford's intermediate lines get only modest grille changes.

Maverick will be offered in a 110-inch-wheelbase four-door model to be sold through both Lincoln-Mercury and Ford dealers. The L-M Maverick will be called the Comet. It will cost slightly more and sport more optional equipment, including a 302-cu.-in. V8 engine.

Ford's Mustang and Cougar will also be completely restyled. Ford will continue all body styles in these model lines: convertible, notchback, and (in Mustang) a fastback. Most striking in the sporty group is Mustang's fastback, a design that looks like something out of Daytona.

Chrysler. Chrysler will slash 27 models in a move to cut costs by reducing the variety of cars offered by the company. Although no firm numbers are available from other makers, Chrysler's cut is expected to be copied by GM, Ford, and American Motors in coming years. Specific models dropped in the cutback are Belvedere and Coronet two-door sedans, all convertibles except Barracuda and Challenger, Imperial Crown two-door, Polara station wagons, and all Monaco 500 models.

Chrysler will rearrange its model lineup to end duplication, especially in the sporty intermediate grouping. Five Charger models will be built, all two-door hardtops. Two of these will replace the discontinued Coronet models. Dodge will get a version of the Plymouth Duster, call it the Dart Swinger and Swinger 340. This car will be built on the Duster 108-inch wheelbase instead of the Dart 111-inch wheelbase.

Completely new at Chrysler for 1971 are the intermediate cars. They will have hidden wipers, ventless door glass with a 43-inch-radius curvature, pull-type door handles, and front bumpers that loop around the grille. All these cars will have shorter wheelbases and shorter overall lengths, but overall width will be slightly greater. Two wheelbases will be built for the intermediates, a 115-inch for the two-doors, a 117.5-inch for sedans and wagons. Rear track has been widened: 3.2 inches for hardtops and sedans, 4.2 inches for wagons.

Intermediate wagons will have built-in air deflectors for the rear window and a new tailgate that opens like a door, even with the window in the up position.

Dart and Valiant will have minor changes to grille and parking lamps.

Full-size Chrysler, Dodge, Plymouth and Imperial models continue the same sheet metal for the most part, and are changed in grilles, taillights, rear bumpers, and fender ex-

Continued

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The '71 Cars

[Continued]

tensions. All these cars will have power front disk brakes standard.

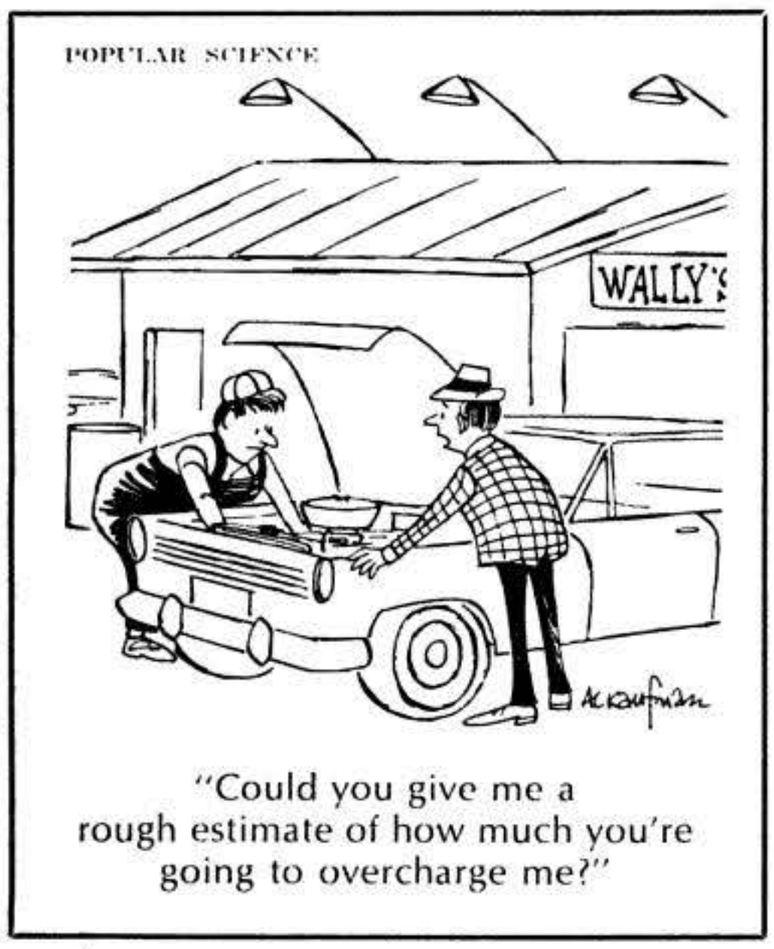
Most interesting mechanical design is the proposed four-wheel skid control that will be offered on the Imperial. The system is made by Bendix, and is the first to control skid on all four wheels instead of just the rear wheels, as the present Ford and GM units do.

Chrysler will also have a new 360-cu.-in. V8 that is designed especially for full-size-car use. Taken from the 318 V8 design, the new engine features smoothness, quietness, and low-speed torque. With a compression ratio of 8.7:1, the stroke is 3.58 inches.

American Motors. Fresh from the introduction of Gremlin and AMX/3, American Motors has an all-new Javelin ready for 1971. The sporty car features raised front fenders that follow the curvature of the wheel wells, but still retains the successful Javelin look of previous years. AM also will put rubber-covered bumpers on the Javelin as an extra-cost option, a technique that will spread to all sporty cars during the coming months.

Ambassador and Rebel are scheduled for a major change in 1972, so the new models will have only facelifts this year. Rebel's rework will be more extensive, though: The sheet metal is all new, from the cowl forward. Ambassador has a revised grille insert and tail lights. American Motors' other cars, Hornet and Gremlin, will be virtually unchanged, since they were introduced for the first time within the last 12 months.

There you have it. Even though the small cars are stealing all the headlines, Detroit is not forgetting its bread-and-butter changes. Whether you plan to buy a car that is small, big, or in-between, you'll find something new in the '71s. PS



"Could you give me a rough estimate of how much you're going to overcharge me?"

Build This Pop-Up Camper

[Continued from page 66]

any lifting action at turnpike speeds.

On our trip, we avoided loading the floor of the galley with luggage; you add enough weight here by stocking the cupboards. Keep as much weight as possible forward, over the wheels.

Easy to set up. One great advantage of this rig is the ease and speed with which it sets up when you've arrived at camp. In fact, I got so good at it that neighboring campers would gather around, asking me to run through the steps again. It reached the point where my kids were taking bets on how fast I could do my act.

The "Dutch" door at the rear is glazed with storm-window plastic bought in a hardware store. I avoided safety glass because of its weight. The use of ordinary window glass isn't recommended; in some states it's against the law.

The cap is all aluminum, made of 0.030 anodized sheets (they come 48"-by-120") over a frame of 1/8"-by-1"-by-1" angle made by Reynolds. Assembly is by means of Pop rivets —the new liquid-and-pressure-tight aluminum type (Cat. No. A42CE). If you can't find these at your hardware store, ask the dealer to order them for you. They are self-sealing and will give a watertight cover. (Regular Pop rivets, when set, have a hole clear through.)

To make the two long seams and the peened-over side seams watertight, I went to 3M Weatherban No. 202 sealant. It comes in cartridges, applies easily, and makes a tight bond if both surfaces are free of grease and grime. I also ran Weatherban along some of the long front-to-back ribs, where it acts as an adhesive and keeps the large aluminum-skin sheets from vibrating.

After trying several types of locks for the folding side panels, I settled on Amerock's No. 7020 cam-action sash locks. The same company offers a new magnetic self-closing hinge (No. T-7629) that worked so well on the camper that I've since been pressured by my wife to change all the hinges in her kitchen.

Off in minutes. The three units of the camper can be unloaded from the station wagon as fast as they went on. Removing both 5/16" pivot bolts releases the cap so it can be lifted (one man on each side) and carried free. To remove the other two sections, you first loosen the 1/4" bolts at the four rain-gutter brackets. (When you shop for these brackets, buy the strongest available. I chose a set made by Sal Metal Products Co., 120 Freeman St., Brooklyn, N.Y., and marked Samsons Surfboard Carrier No. 3100 S. My modifications are shown on the set of POPULAR SCIENCE Projects Plans described on page 66. I've since found an even heavier-duty car-top bracket made by Leichner Mfg. Co., 1510 N. Neil St., Champaign, Ill.)

Next, remove the four 1/4" carriage bolts that secure the overlap at each side. Finally, at the rear of the galley section, just under the lifting handles, are the 5/16" threaded tie rods that hook under the bumper. Their turnbuckles should be only hand-tightened so no strain is put on the overlap. Disconnect the tail-light electrical harness and lift the galley free.

I usually set it on my youngster's little red wagon to wheel it into the garage for storage. But the Project Plans show a wheeled dolly that you can build at your leisure.

Even though the wagon's tail lights are plainly visible with the camper mounted, I added a set to the rear of the camper and moved my license plate to that new location.

Because of the height of the tailgate, climbing in and out of the camper is a strain. We solved this with the purchase of a three-step aluminum ladder, which we carry folded on the floor of the galley. I added two triangular brackets to the rear legs which just fit under the galley section and keep the camper from bouncing every time someone steps aboard. The kids used the ladder for climbing into the upper bunk, as well.

Two final suggestions: Install a rear-view mirror on the right side of your wagon; it's needed for getting back into the cruising lane after passing a car. You're still able to use your inside mirror, but it gives you tunnel vision—straight back, with little to either side.

And call your insurance agent for assurance that you're covered for toting something on top of your wagon. Be sure he understands what the camper is, and get his confirmation in writing. Some policies don't cover anything carried on top of a car.

One for the road. A patent (No. 3-411-819) has been granted for a station-wagon car-top camper, so the use of this design for any commercial purpose is prohibited. Purchase of the plans, however, includes permission to build a single unit for your personal use.

And if you don't want to tackle the construction, you may be able to buy such a unit readymade. As this issue went to press, a company named Consolidated Camper Corp., 450 Seventh Ave., New York City 10001, had been formed to market it. Write them for information and price. PS

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Build a ZOOM SWING

[Continued from page 96]

side frames. To do this, I cut six seven-degree wedges, used in final assembly as the crossmembers are bolted to the side frames. This is a good deal easier than attempting to make 97-degree miter cuts here and there on the hard-to-handle four-by-four stock.

The dimensions shown in the drawings are not critical. The swing could be higher than the 8′ shown—and it could be about as long as you want it to be. The track comes 12′ maximum, but splices are simple at hanger points. However, don't increase the height without increasing the length, or the entire swing frame will pitch forward when the swinger comes to the end of a cycle. The 8-by-10 proportion is about right.

Worksaving tips. Actually building the swing turned up a few:

1) Assemble the frames on a driveway, one on top of the other. Put in the diagonal cables and snug up the turnbuckles.

2) Stand one side up against the garage. Maneuver a car into position and lean the other side against it, so the two sides are about the right distance apart. Then install the crossbeams.

3) Enlist the help of some friends and carry this assembly to the spot where it will finally stand. Spread apart the bottoms of the frames the proper distance, and tap stakes into the ground at the ends, to hold them parallel.

4) Install the diagonal strap braces at the upper ends to provide lateral stability.

5) Remove the bolts from the BBXT2600 hangers and replace them with eyebolts. Close the S-hooks on the eyes of the bolts, and hook on the two chains. Cut the chains to actual length later.

6) To keep the hangers from running off the open ends of track, cut four 1′ lengths of two-by stuff to slip inside, bolting them as shown in photo. Put the stops in one end of each length of track, insert the hangers, then put the stops in the open ends.

7) Mount the tracks, using the standard brackets that go with the track.

8) Assemble the seat—an 18″ length of ¾″ plywood about 9″ wide and a pair of U-bolts—as seen in photo, and suspend it from the chains.

There's no need to paint the cedar used in the Zoom Swing, unless you want it some color other than the natural silver gray the wood turns, as it ages. A wood preservative on the lower rail is a good idea. PS

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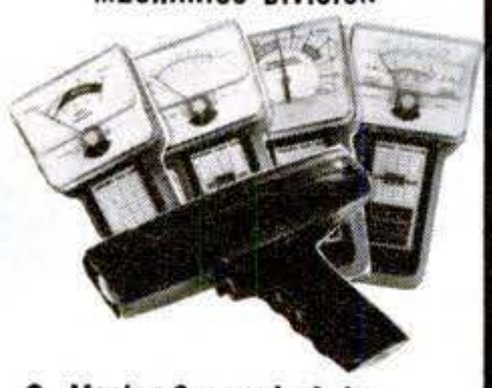

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Anti-Car-Theft Device Competition

[Continued from page 72]

dant's card for use as an aid in stealing the car has no value.

The underhood unit is a compact solid-state electronic panel containing a series of AND gates and another of NOR gates. (An AND gate allows current to pass when both inputs are present. A NOR gate passes current when neither input is present.) The holes in the cards channel currents to the proper gates in accordance with the selected code.

The circuit board makes provision for the addition of an optional safety feature that would stop the engine as the driver leaves the car. This is accomplished either by making a connection to the courtesy-light switch in the left front door or to a pressure-sensitive switch under the driver's seat. An impulse from either switch (caused by the driver stepping out) would cut the ignition.

A basic feature of the invention is a removable multi-conductor connector at one corner of the circuit board. The manner in which this connector is cross-wired determines the response sequence of the various gates, and thus the pattern of holes the acceptable cards must have. Changing this connector would be the equivalent of altering the combination of an ordinary tumbler lock.

Hawkins has far-reaching ideas for use of this instant changeability. He proposes that automobile manufacturers ship all cars with a single universal code for which dealers and transporters would have the necessary plastic card. This would eliminate the bookkeeping needed to keep present numbered keys identified.

When a vehicle is sold, the dealer would replace the factory-installed connector with one cross-wired in a pattern unique for that particular owner. An owner could even have all cars in the family responsive to a single set of plastic cards. A change in the "combination" could be made later in minutes if the owner wished it for any reason.

Second-prize winner. Donald C. Peroutky also uses a card-type "key" for his invention, but he adds a highly ingenious electro-optical twist. Each hole in his card contains a disk of a newly developed proprietary material with the unique ability to refract a beam of light directed through it. The degree of refraction can be tailored so precisely that the beam can be diverted into any chosen one of the 30-degree segments of a circle.

The result is that each card hole offers the equivalent of 12 holes when it comes to setting up lock combinations. Peroutky divides the light target in his model into only nine segments, however, to achieve greater separation and increased accuracy.

With only six holes, he says, his card can provide 999,999 different "combinations." By adding a hole, or at most two, every automobile in the U.S. could have its own exclusive card, ineffectual on any other car.

The Peroutky system also has a small "reader" box on the instrument panel. When a card is inserted, small pilot lights supply the beam for each card hole. Solid-state photoelectric detectors respond to the light only if it comes through in the prearranged pattern, and then actuate relays for ignition and other functions. The reader promptly ejects the card in order to eliminate the key-left-in-car syndrome.

The third-prize winner. W. D. Lothe also employs a card in place of the standard key, but his concept is to-

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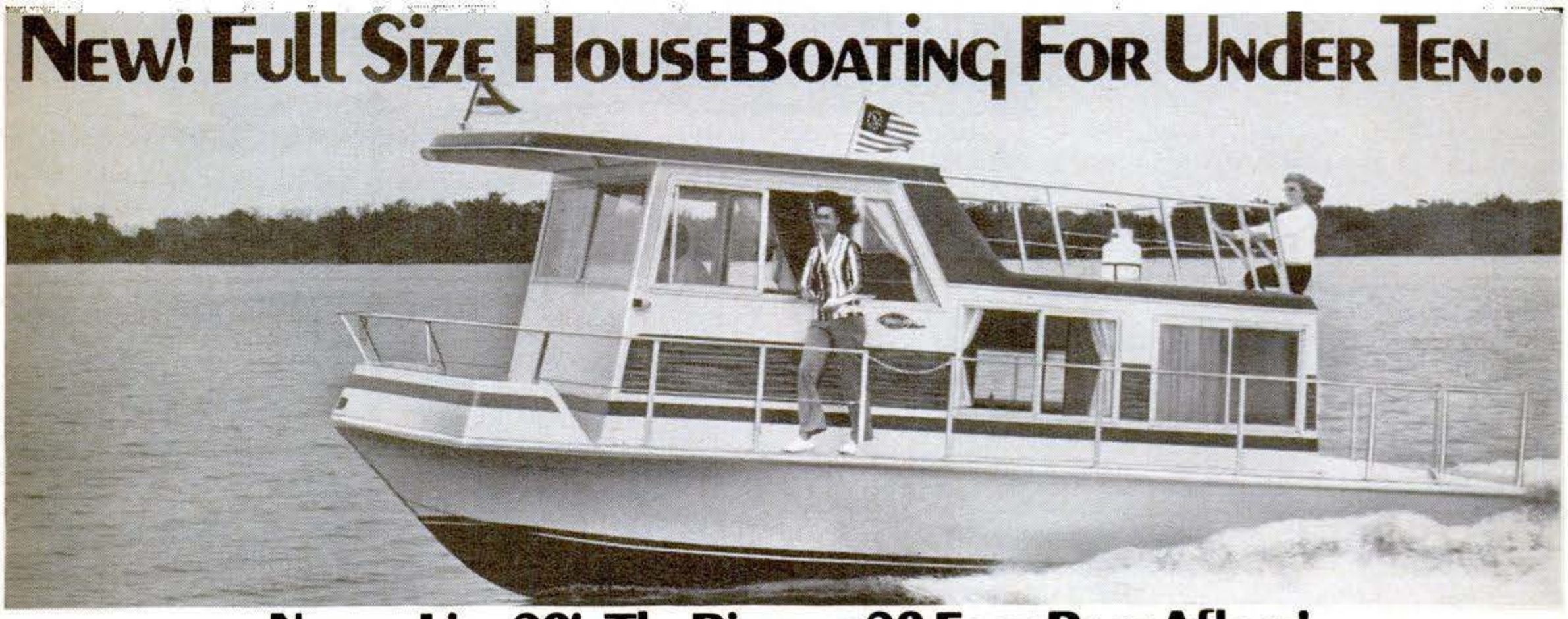

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tally different. His card contains components such as capacitors and resistors and becomes part of an electronic circuit, whereas the cards for the two previously described devices act only as switches.

The Lothe device consists essentially of two oscillators or pulse generators. The frequency of one, the internal standard, is fixed at the time of manufacture, or at a later time of "combination" setting. The frequency of the second oscillator is determined by the components in the card "key." When the pulses coincide (with use of a correct card), AND gates, amplifiers, and rectifiers generate the necessary current to close a relay and activate the ignition. The card must be removed to stop the engine.

A continuous series of controlling pulses is generated by an internal electronic "clock." This is a protective measure; it prevents electronic bugging by a thief with a variable oscillator.

The fourth-prize winner. David L. Pippen has designed a system in which the starter-motor solenoid is responsive only to a high-frequency alternating current. "Jumping" with the low-voltage DC available from the car battery is ineffective.

A module in the ignition switch generates the high frequency when a standard key is turned, and another module in the starter transforms this into a form useable by the solenoid. Subminiature solid-state components perform all these electronic jobs.

The standard ignition switch is retained, modified only by internal addition of one module. The usual, easily accessible hot terminal of the starting motor is replaced with an internal connection.

Looking back on the Competition and the flood of entries, we find several aspects of the original auto-theft problem have been attacked.

The also-rans. Keeping the engine space inviolate became the first order of business for many of the inventors. They accomplished this with electric solenoid latches that prevented the manual release from operating, with mechanical cables, and even with means responsive to the oil pressure in a running engine.

About 100 entrants confined their efforts merely to the ejection of the ignition key in order to prevent the key-left-in-car robbery. Some contented themselves with a simple coil spring surrounding the key (is this practical?); others built ingenious ejectors into a common ignition switch.

Some entries were the epitome of fine workmanship, and would do credit to a good professional model-making shop. Others were what might be called "loose" in their rendering.

The smallest device entered in the competition fit easily into the palm of my hand. The largest was bigger than a coffin and required two men to jockey it around for examination.

Even the professional jokers were in evidence. One inventor had a large sign with the legend STOLEN CAR pop up on the windshield when unauthorized driving was attempted. Another provided two placards—one for the front and one for the back of the car, which the owner was to apply when he left the vehicle—carrying messages appealing to the thief's conscience.

So it's over—and I hope that the combined efforts of all of us will have made the life of an auto thief a good bit harder. PS

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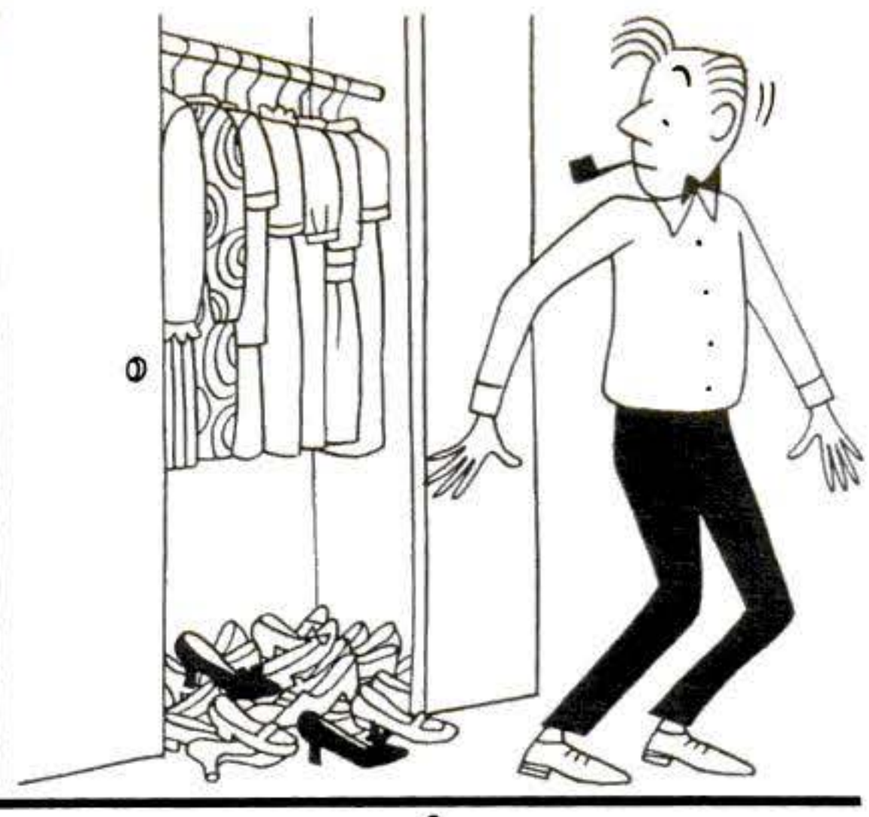
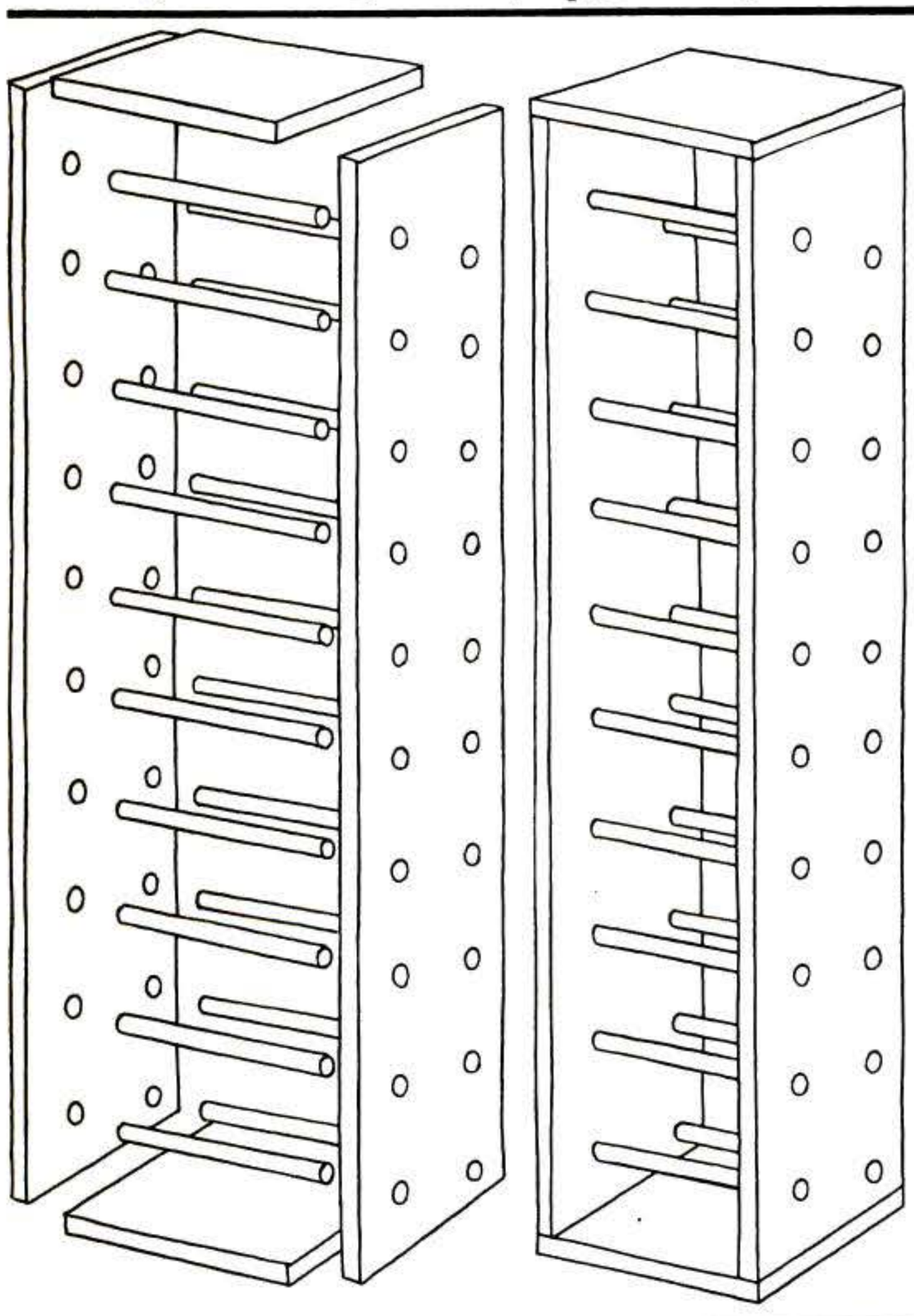
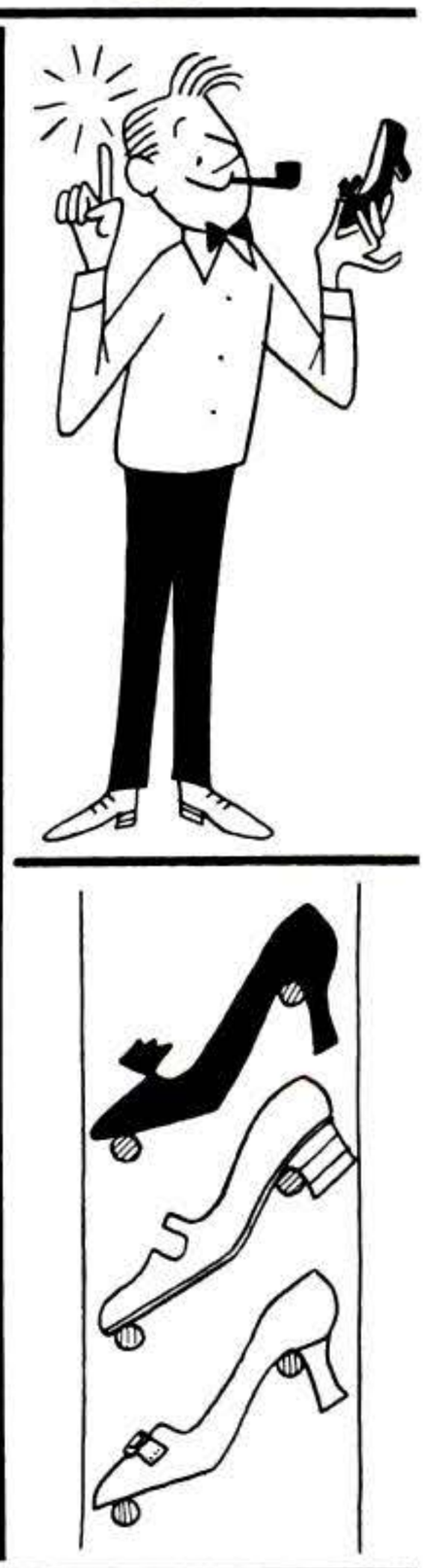
Wordless Workshop

By ROY DOTY







Planes You Can Build

[Continued from page 100]

also provide a bibliography of more specialized books—on wood, welding, dope, fabric, etc., all from EAA.

Basic, step-by-step requirements for homebuilts are outlined in the *Civil Aeronautics Manual* (CAM 1.74.3). FAA regulation FAR 23 spells out airworthiness requirements which, if followed, should get you airborne.

Getting the out-of-print *Civil Air Manual 18* from EAA ($3.50) is a must before visiting the local FAA office, where you pay $5 for serial numbers, and give your plane model for registration. The application for the annually renewable, airworthiness certificate (Form FAA 305) is addressed to the local FAA office, with a covering letter outlining planned flights and enclosing a photo or drawing of the projected plane, including its external dimensions.

Ready to fly. Upon completion, the FAA will inspect the plane, and if approved, you have an experimental certificate (Form ACA-1362) to fly: but the word "Experimental" must be stamped in a readily seen spot.

Safety policies concerning the plane's occupants are in CAM 1.74.3. It recommends installation of safety belts; use of approved components, standard instruments, proper octane-rated gasoline, carburetor heater, firewalls; and that the power-installation test be made on the ground.

After approximately 50 hours of testing the completed aircraft (75 if the engine isn't FAA-approved for aircraft), the builder informs the FAA Safety Agent in writing to request less-stringent operating limitations: Nonpaying passengers may be carried, and the operating area is usually enlarged to include all of the U.S., except highly populated areas.

Bolted onto the panel is this ominous, yet mandatory placard: "This aircraft is amateur-built and does not comply with Federal Safety Regulations for standard aircraft" ($2.25 from EAA).

Engines and equipment. Some engines are quite scarce and costly. *Trade-A-Plane*, a newspaper available from your local fixed-base operator, lists a used 65-hp Continental engine for about $500, but a late model in good condition could cost $1,000.

Second-hand hardware items are useful: metal propeller, instruments, wheels, brakes, fuel tank, and engine mount. Besides the engine, the largest outlay will be for tubing, wheels, brakes, spars, fabric, and dope.

Simplicity in construction. All designers stress clarity in their plans and can substantiate performance claims. They even simplify the build-

continued

Planes You Can Build

[Continued]

er's work through updated bulletins.

The Baby Great Lakes biplane of designer Barney Oldfield requires no jigs, except for the wing. The aircraft is built on a flat piece of plasterboard, according to Harry Swack of Great Lakes Aircraft Co., Cleveland, who sells the plans:

"Make a layout on plasterboard and clamp to a pair of two-by-fours, build each side, and tack-weld them together in the diagonals. Each side completed, space them on a couple of horses inverted, and tack in cross members. Then heat the longerons until they sag over the center line. And repeat for the other side."

The Baby Great Lakes is also inexpensive, requiring only 136 feet of tubing in the fuselage. Welding can be done in 40 man-hours. But unless you are experienced, you should *only* tack-weld the tubing, and pay an expert to finish. Anemic welds are not desirable at 5,000 feet.

Several time-saving materials kits are available: fuselage tubing cut and shaped for welding, completed fiberglass cowlings, finished wing spars, and formed metal parts.

Flight characteristics for the more conventional homebuilts with 100-mph speeds are more accommodating at first than faster ones. A cautious attitude is more important than 1,000 hours of logged flying. One World War II B-29 pilot let his homebuilt get away from him, ground-looped, and seriously banged up a wing. But another homebuilder, only a student pilot, has never had any trouble.

Before flight testing you should first log a certain amount of time in a plane with a similar sink rate and landing speed.

Feeling out your homebuilt progresses from the known to the unknown—from ground taxiing, to pattern flight, to slow flight with stalls, to climbing tests that evaluate engine-cooling. *Only* after everything is checked out, and if legally permitted and the ship so stressed, should aerobatics be attempted.

"Approach flight in a positive way," advises Lyndon Cockroft, economist from Bowie, Md., who finished his Wittman Tailwind eight years ago and has flown it 900 hours on extended cross-countries. "Inspect your structure step-by-step. Then—

- if welds are fine,
- if the wood has no splits,
- if your rivet work is good, and
- if you worked through the local FAA, GADO, or EMDO (Engineering and Manufacturing District Office)—your project can't help but work successfully."

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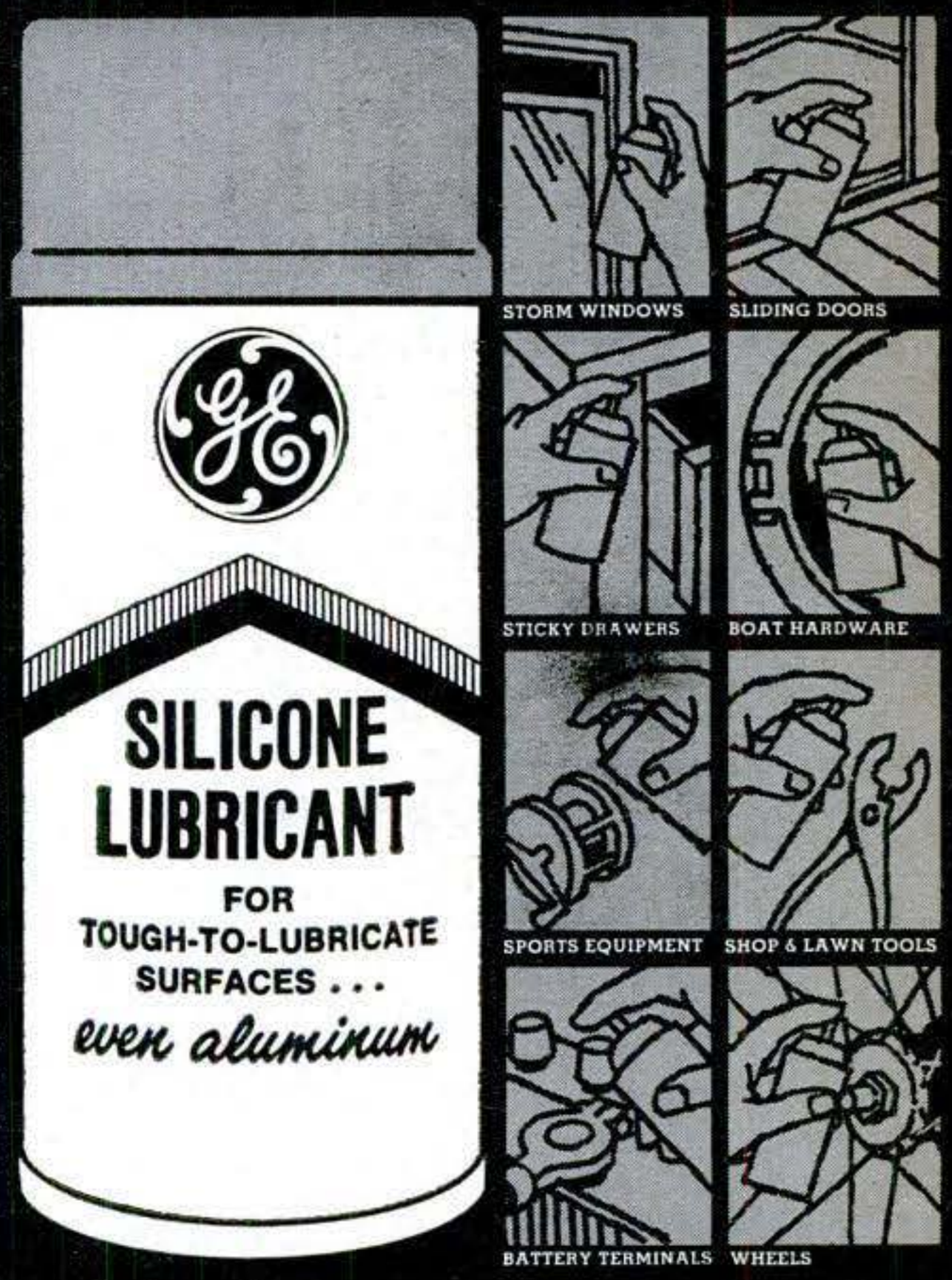

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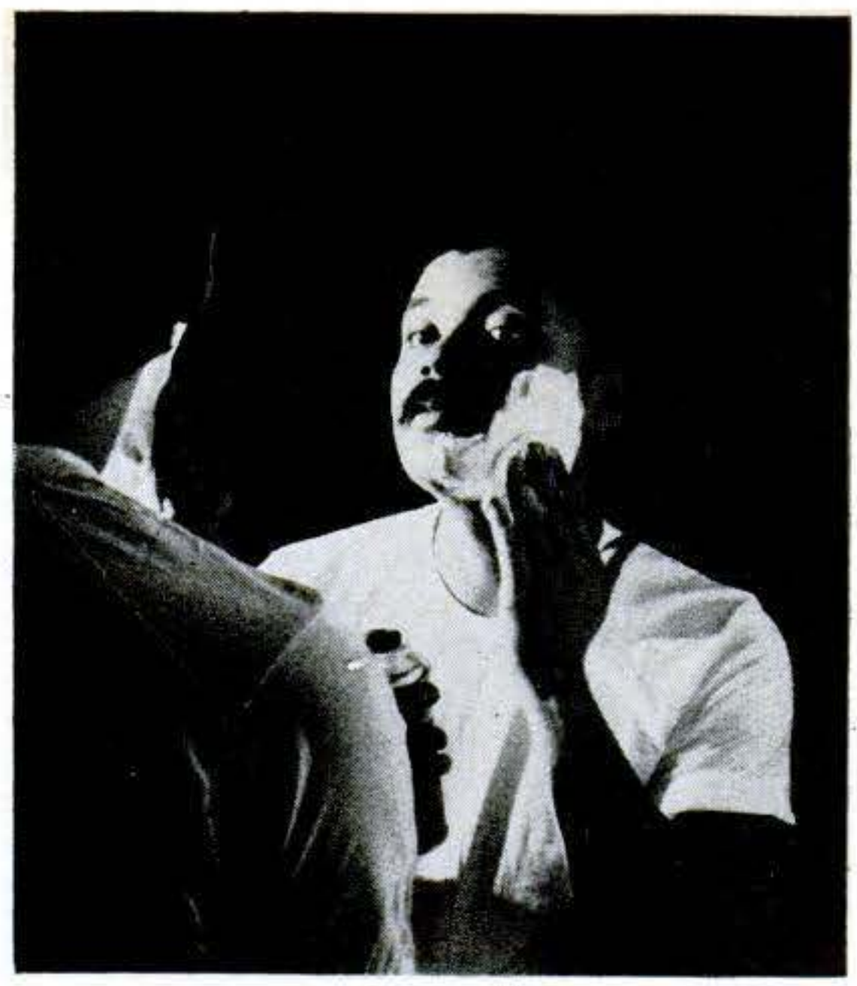
Edge comes out of pressurized can as a gel on your fingers (below) and turns into lather on your face (right). Johnson Wax, maker of the new product, says that the gel medium enables it to load Edge with extra lubricants and moisture to provide increased protection against nicks and cuts.



Bag Inside a Can

New kind of pressurized package keeps product and propellant separate

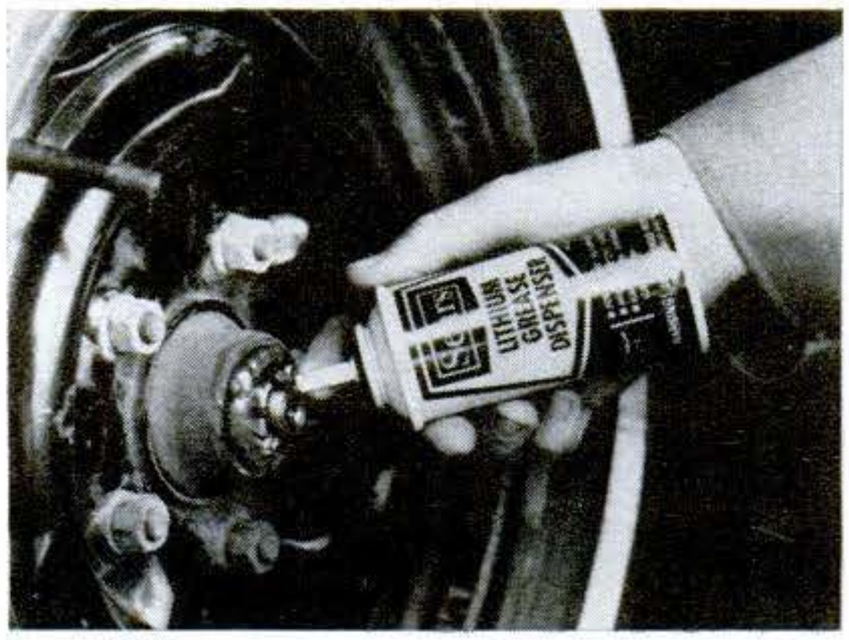
You've probably used hundreds of aerosol cans to dispense everything from shaving foams to vermouth with astonishing ease.

But so far, these pressurized cans have only been able to dish out sprays and foams. Now science has perfected a new type of pressurized package that will let you dispense more viscous substances, like gels, greases, and caulks, with aerosol convenience.

A new shaving preparation called Edge, by Johnson Wax, is one of the first products to be packaged in this second-generation pressurized can. Unlike other whisker-wilters, which emerge as foam, Edge oozes out as a gel—but foams into lather on your face.

What keeps Edge a pressurized gel? It is stored in a plastic bag within the can and thus separate from the propellant, whereas in aerosols it is dissolved. The propellant pressurizes the bag to squeeze out its contents. And the bag folds up until all the contents are gone.

New shaving product comes in Sepro can, made by Continental Can Co. The can has a plastic bag inside to separate product from propellant.



Sears lithium grease is another viscous product that comes in new can. Caulks and ointments are also available in this dispenser.

Fantastic Elec-Trak

[Continued from page 70]

utes with the grinder, driven by power from the tractor plug-in.

Emergency power. Customers with an eye to home power failures may contemplate the potential of the tractor powerpack for emergency power. GE has thought about this, too. They offer an inverter to provide 60-cycle, 115-volt power for lighting, and they're working on a unit that would keep your furnace or well pump going for a while during emergencies.

Okay. What about the batteries? How long will they last, and what would it cost to replace them?

- A charge will give you six or seven acres of grass cutting.
- Warranty life is five years; expected average life is eight to 10.
- Batteries cost $32 each, $192 for all six.

In practical terms, the tractor will run longer on a single charge than any ordinary owner is likely to use it in a continuous session. The batteries, an advanced lead-acid design, actually have about 25 percent more power after two years than they do new. This results from increased surface activity.

Running costs. If the cost of the batteries, plus the cost of charging at usual household rates, is compared with the cost of gasoline, electricity is the winner. Assuming you buy regular gas at about 35 cents a gallon and burn two gallons an hour, you're probably looking at $58 per season (based on 20 hours a month for four months). Disregarding oil, spark plugs, tune-ups, etc., this amounts to about $232 in four years. Even if you ignored the Elec-Trak warranty and bought a whole new set of batteries after four years, you'd spend only $192.

Initial cost is in the ball park, as well. The recommended base prices are: $1,150 for the 10-hp E-12; $1,295 for the 12-hp E-15; $1,495 for the 14-hp E-20. This is about midrange for comparable gasoline tractors.

There are, of course, differences in detail between models. For example the two smaller machines offer the option of standard or heavy-duty batteries. The drive train, power lift tires, and physical size are all a bit different on the big E-20. All models are 69 inches long—certainly man sized. The E-20 is 42 inches wide compared to 36 and 37 inches for its smaller brothers.

No matter how you look at it—from the antipollution angle, in noise abatement, safety, starting convenience, portable power features, or just performance—this tractor is going to shake up the market! ■

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Factory-Built Houses Will Cost Less, Give You More

[Continued from page 55]

hoisting up the building than factory production for transport to a site.

The fact is that most modulars still use standard materials. With such non-housing industrial giants as Union Carbide, U.S. Steel, Chrysler, Alcoa, Dow, Westinghouse, Ford, General Electric, Monsanto, Reynolds, American Cyanamid, and others moving into the field of modular housing, you can be sure of a tremendous research effort into the field of new materials. But as of now, the vast majority of modular houses are built of the same materials as standard houses. It is mainly the methodology that is improved.

How they're built. To begin with, walls are built flat, then erected. (Those of you who can remember an engineering feat of yore called a "barn-raising" will note the similarity.) The difference is assembly-line techniques that turn out flats by the hundreds with automatic nailing machines, glue spreaders, gang saws, sanders, paint sprayers, and floor-covering applicators. Several tricks are in use for making the stand-up easy and foolproof. General Electric, for example, has an L-shaped corner that stands by itself while flats are tilted up and fastened to it. By keeping the L's jigged in proper dimensions, the factory hands can be sure of true and square modules.

As the flats go together and rise into a three-dimensional shape, wiring, plumbing, heating, and air-conditioning runs go in place, carefully positioned for butt-together hookup on site. A completely centralized utility core lowers costs still further.

Tremendous savings in time and labor result from continuous operations, such as putting down—almost literally—acres of hard-surface flooring on prepared subfloors, then cutting this raw material into module sizes.

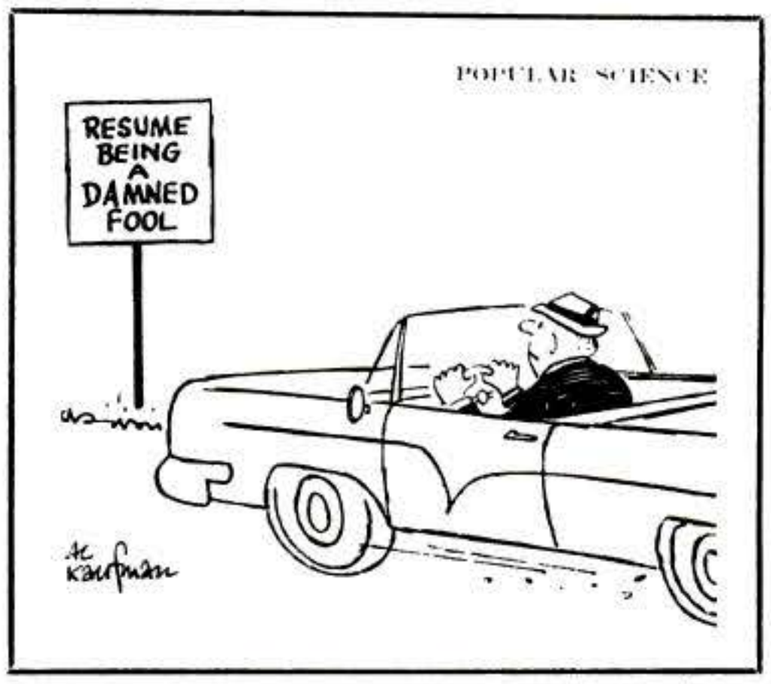
Ingenious methods. Many ordinary construction routines are ingeniously translated into instant production. For example, General Electric has a wall with metal studs and expanded metal lath which is lowered flat into a shallow pool of plaster. When they lift the wall, it is plastered, about as quick and easy as you'd dunk a slice of bread in a pan of gravy.

Since floors don't have to be strong enough to walk on while they are being put together—as long as they are strong enough when they are finished—it is possible to eliminate a certain amount of "joisting." For example, huge plywood sheets on top of and below a five-inch-thick honeycomb of heavy plastic-impregnated paper provide a stressed-skin strength great enough for residential spans up to 10 feet and more.

Multiple-dwelling applications. Since a great deal of the research into modular home construction is prompted by the interest of the Department of Housing and Urban Development and by the Operation Breakthrough competition, apartment and multiple-dwelling design has come in for much attention. In only a general way does the modular single-family house or "town house" parallel the methods intended for modular apartment houses. Take one critical difference: The typical house module is built rugged enough to support a second floor—or in special cases, three or four floors. But, when you get into high-rise, you must construct a skeleton into which modules are inserted, supported by the skeleton instead of by each other. It is also necessary to provide fire barriers in high-rise buildings, to prevent a fire in one unit from burning out 100 families' dwellings. Such fire barriers usually mean too much weight for easy transport. For that reason, modular high-rise construction usually means savings made possible by production-line assembly of building units *on* the site.

Architects and builders point out, however, that the vast majority of multiple-dwelling construction in this country is four stories or less in rise. Thus, the extreme savings and efficiency of modulars produced in factories also give residents of town houses, condominiums, and the like a break in costs and availability.

Next—the modular factory? It's here—or nearly here, as worked out by General Electric. First you build a factory on 20 or 30 truck-trailer beds, bolted together side by side and end to end, covered with an inflatable roof. When you finish building houses in a given area, you hook tractors to the trailers, and parade them off across country to the next area that's in line for a housing boom. Not the house that Jack built, to be sure, and about time. PS



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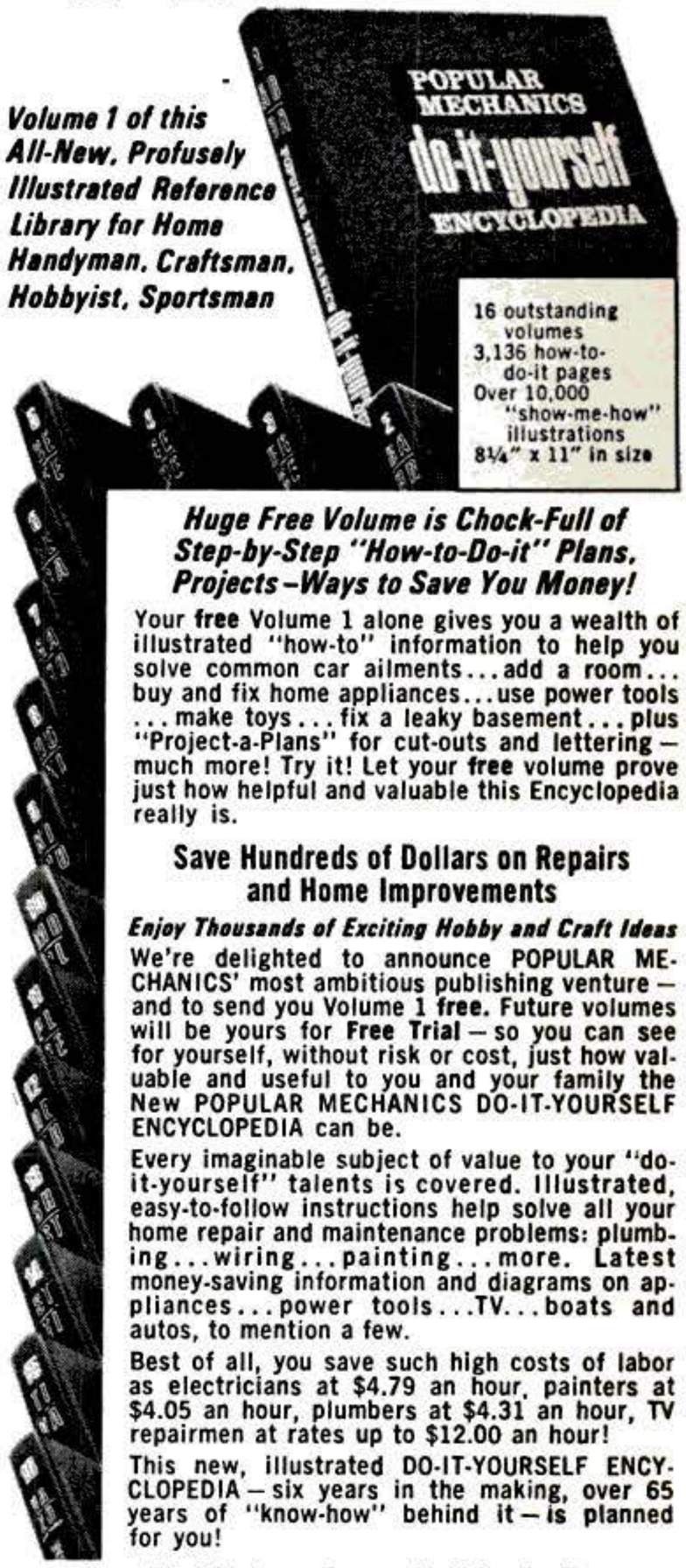

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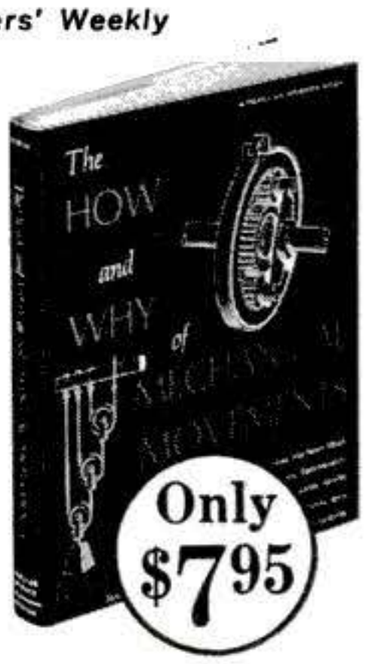

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CATV Is Coming to Your Town

[Continued from page 89]

out the channel, a small converter on top of the TV set is used. This device has one or two selector knobs on it and sends a new signal to the TV set's antenna terminals.

A single-knob converter will have 12 channels numbers on it along with a few lettered channels—channels A, B, C, D, etc. Many of these converters have as many as 20 channels indicated on them. And some CATV systems actually deliver 20 channels or more! Generally, all systems in big cities, and any systems with more than 12 channels, must have a converter on top of each subscriber's TV set. There's at least one converter that attaches to the rear of the TV set and lets you use the UHF tuner to select the channels. But UHF tuners don't have the click-stop pretuned channels that VHF tuners and regular converters have, so tuning in is a little more difficult.

Some CATV operators offer an FM option for an extra $1 per month. Where it is available, the cable FM usually has its frequencies converted to another spot on the FM dial to avoid interference problems. But the same FM receiver is used and no converter is necessary.

The wired city. Eventually, a large part of the country will get its TV programs from cables instead of antennas. Entire cities—big and small—will be wired for TV. Many small communities are entirely cabled now, and others are following every day.

What usually happens is that some large cable operator or hardware manufacturer presents a proposal to a town that's ripe for cable. There may be three or four such proposals submitted at about the same time.

The successful applicant has to make several concessions to the municipal government. For one thing, he pays a tax of five to eight percent of gross revenues. He has to provide two-way cable to schools and municipal buildings so programs can originate there for the local channel. This is made easier by some new hardware—two-way line amplifiers that handle TV signals going in either direction on the trunk cable.

The Federal Communications Commission regulates CATV, but there's still no firm body of rules, and the commission is still trying to make up its mind what to do. Final word is still with the local municipality that grants the franchise.

Super-service on the way. Cable means more service from your TV set, but entertainment isn't the only use for the cable. Right now, TV programing is what gets the cable into your house. Five years from now, or even sooner, other special services like TV shopping will be added. This lets your wife watch the latest sales at her favorite shop on TV, so she can call and order what she sees on the tube. Soon, she won't even have to call—just press some buttons on a touch-tone data set near the TV set.

Fire and burglar alarms that tie in directly to police and fire stations are also high on the CATV priority list. Cable will usher in an era of the electronic facsimile machine.

In congested cities that have no more room for underground cables, short-hop millimeter-wave microwave beams will carry CATV channels to major building groups cheaper and easier than trunk feeders could. And entertainment opportunities will multiply a thousandfold as more distant signals are imported by microwave and domestic satellites make CATV networks possible. Eventually, some UHF TV stations may go off the air, turning instead to the cable. Ultimately, if all UHF stations vacate their over-the-air transmission, the FCC will be able to re-allocate those frequencies for much needed communications use. The VHF stations will stay on the air to reach those people not touched by cable—the portable TV at the beach, remote rural locations, and even the back seats of limousines.

Channels by the hundreds. By 1990, according to a recent analysis by Nathaniel Feldman of the Rand Corporation, each U.S. "neighborhood" with an average of 2,000 subscribers could support its own cable TV center with an astounding 100 to 400 channels on tap.

What would your town or neighborhood *do* with that many channels? First, the regular 13 channels of programs could be repeated at different times of the day on other channels, so that you would never have to miss your favorite show. This could account for 100 channels. Scores of lecture classes for students and the general public could be scheduled. Professionals could keep up with their specialties by viewing special courses. A local rock group could put themselves on the air at a cost of perhaps $20 an hour. Local affairs could be covered with an intensity to delight any politician's heart.

Some experts are predicting—for less than the cost of the family car—a complete home communications terminal with access to computer libraries, two-way video, and hundreds of input channels. Cable TV could make it all come true. PS

Propane Power—for Every Kind of Camping

[Continued from page 58]

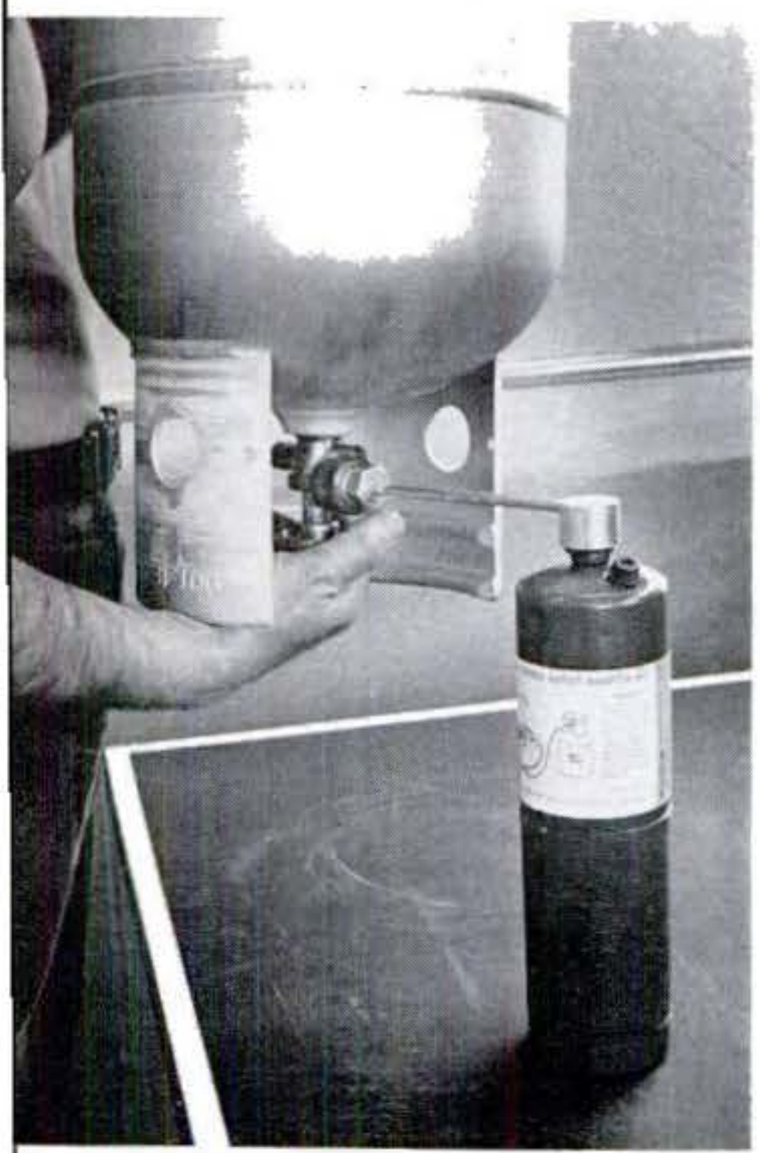
What about cost? A gallon of propane costs about twice as much as a gallon of gasoline. But propane is still a bargain, unless you buy it in 14-ounce disposable cylinders. Then you're paying about 10 cents for 20,000 Btu's of energy and $1.25 or so for the container you throw away.

The safety and convenience of a propane lantern may be worth $1.35 for a weekend. But one summer of lighting *and* cooking could burn up enough money to pay for a 10-pound bulk tank. And for between $1 and $2 you can fill that tank with 200,000 Btu's—enough to last all season.

If you have a tent trailer or utility trailer, it's simple enough to mount a propane tank on the tongue, then at the campsite hook up your portable appliances with flexible hoses.

It's tougher for campers who stow all their gear in a car or station wagon and pitch a tent. The National Fire Protection Assn. says you shouldn't carry any propane container larger than a 14-ounce cylinder inside any vehicle. (Tanks *can* be carried in recessed compartments sealed from the vehicle and vented to the outside.) Their reason makes sense: If gas or liquid leaks from the tank it will settle on the floor and, unable to escape, form a combustible mixture. Or the tank valve could be knocked open accidentally by bouncing gear.

There's still a way to enjoy inexpensive propane fuel without taking a bulk tank along. Now you can buy refillable cylinders for a few dollars more than for the disposable kind. You fill these special containers over and over from your bulk tank. Just carry enough 14-ounce refillable cylinders with you to last one trip; then fill them up again for the next.



efillable cylinder ($3.80) lets you use the ame handy-size bottle over and over for 0 cents a shot. Refill adapter ($3) connects special cylinder, which has adjustable elief valve, to your bulk tank.

How much propane? You can get a rough idea from the table below how much propane to take along. It tells how many hours of operation to expect from one 14-ounce cylinder:

APPLIANCE	HOURS PER CYLINDER
Single-mantle lantern	10-15
Single-burner stove	4-7
Catalytic heater	3-18
Infrared heater	4-12
Refrigerator	40-70

Operating ranges are broad because most propane appliances are adjustable—the lower the setting, the longer the fuel lasts.

If you use 14-ounce cylinders, you can estimate how many to take directly from the table. To convert cylinders into bulk-tank size, figure one pound for each cylinder. If you need 10 cylinders, better plan on a 10-pound bulk tank. A 20-pound tank is the largest practical size for a portable setup—and most tunnel authorities will not let a larger one through.

How to use propane portables. The new portable LPG appliances are made for use outdoors, not inside a trailer, camper, or motor home. Though there is little chance of poisonous combustion products from these devices, they *do* use up oxygen unless permanently installed to use outside air for burning. Occasional use, as in cooking, is considered reasonably safe. But leaving a heater on in a closed space invites tragedy.

If you hook up appliances to a bulk tank, buy the best grade of LPG hose available—it's the weakest link in the system. Then test connections for leaks with soapy water.

Tips on tanks. Buy a fuel gauge with your tank—it saves weighing or guessing. If you go winter camping, choose a squat tank rather than a skinny one; the larger its diameter the more liquid-surface area and the more vapor pressure at low temperatures. Finally, refill at a reliable station. An experienced filler leaves 10 percent of the tank empty as a cushion for expansion, and an overfilled tank is dangerous: Liquid volume increases one percent per 4.6 degree heat rise.

Where to fill up. You can find most of the 10,000 filling stations in the yellow pages. Or send 25 cents to Primus-Sievert (47 Larkin St., Stamford, Conn. 06906) for their *Refiller's Guide*; it lists 3,000 of them. PS

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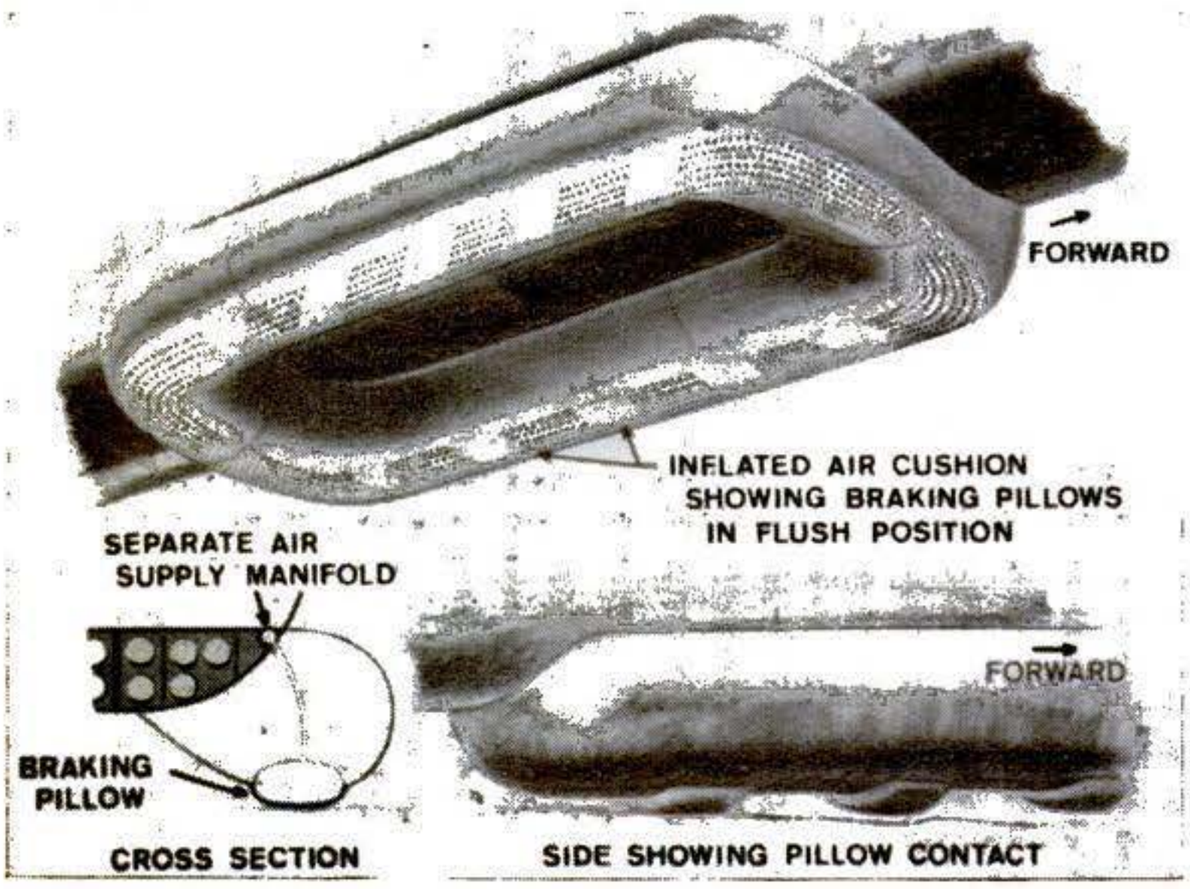
WHEEL-LESS PLANE Lands on a Cushion of Air

By PAUL WAHL

Test landing on a makeshift airstrip proves resiliency of air bag mounted on wheel-less plane. The air bag has survived a series of taxi tests on mud, plowed ground, even over small stumps.



How the air cushion works: Bag releases air through thousands of jet nozzles to create an air cushion. Pneumatic pillows activate six basketball-size brake skids that slow down the plane.

Landing on water, the modified Lake amphibian looks as if someone had glued a rubber life raft to its belly. Actually, that "raft" is an inflated bag that converts this plane into an air-cushion vehicle for takeoff and landing.

The new *Air Cushion Landing System* (ACLS) was developed by Textron's Bell Aerosystems Co. It combines the takeoff and landing capabilities of wheels, skis, floats, and hull, and also lets the plane operate on unprepared surfaces where other landing gear can't go.

The ACLS-equipped test aircraft is a Lake LA-4 light amphibian. It weighs about 2,500 pounds. Fitted to its hull is a 16-by-4-foot air bag shaped like an elongated doughnut, formed of multiple layers of stretch nylon, natural rubber, and neoprene.

Mounted in the rear fuselage, an axial fan driven by a 90-hp engine forces air down into the bag, inflating it to a thickness of about two feet. The underside of the bag is perforated by thousands of tiny holes—"jet nozzles"—through which air escapes to create the 45-square-foot layer of compressed air on which the plane floats.

Irregularities in a landing surface are tolerated by the resiliency of the flexible air bag. This permits taxiing over fairly rough terrain.

The bag is inflated during flight, fitting snugly against the belly of the aircraft. In large, high-speed planes, the bag would retract behind metal doors. For parking, an internal bladder seals the air jets so the bag can support the plane on land, or provide buoyancy to keep it afloat on water.

"Whisker skids" fitted beneath the LA-4's standard wing floats improve stability during ground roll.

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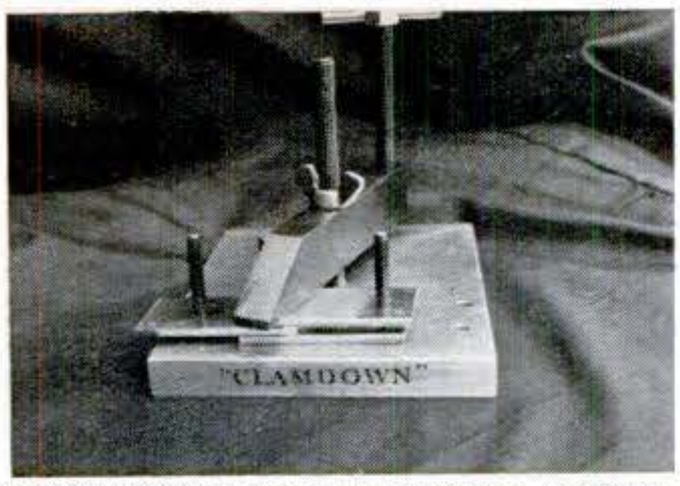

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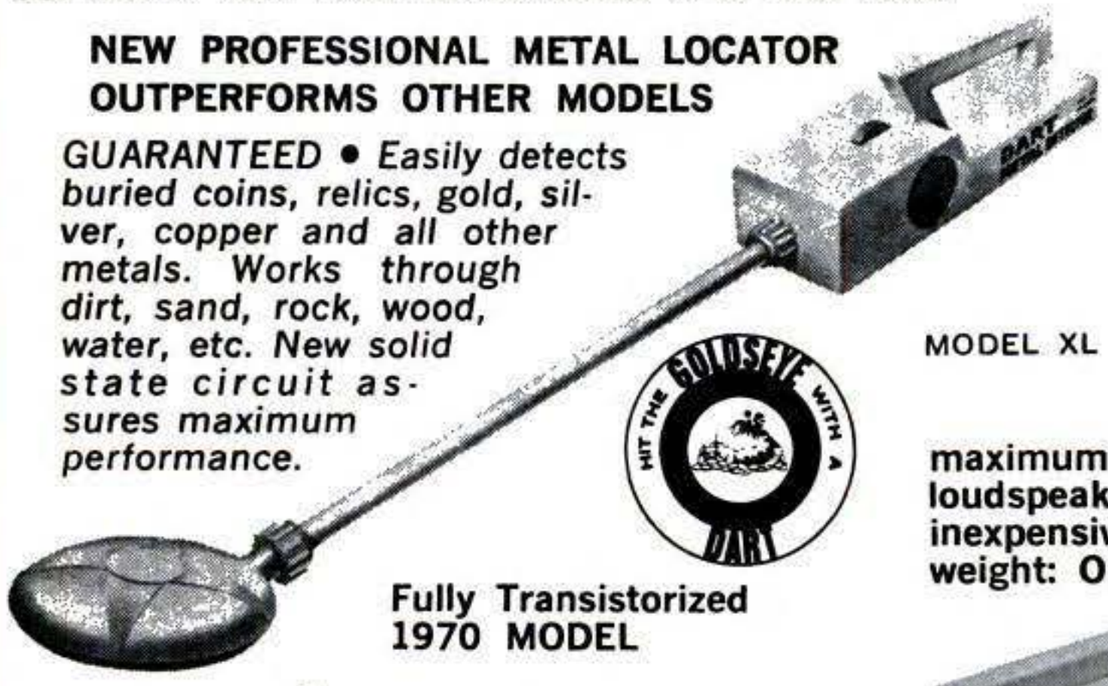

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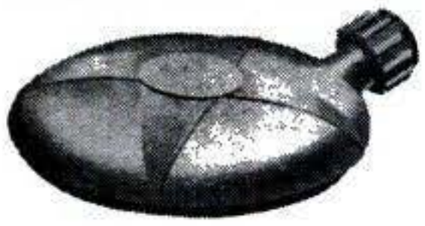

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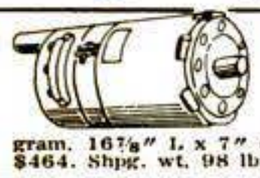

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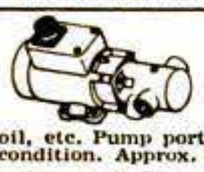

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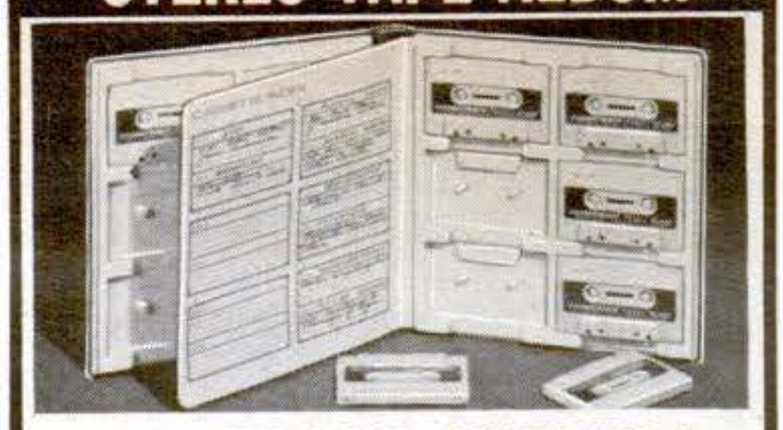

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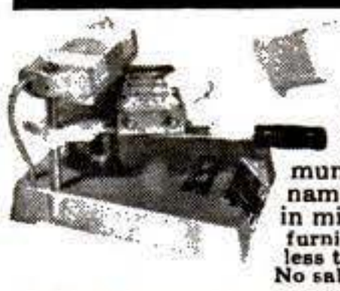

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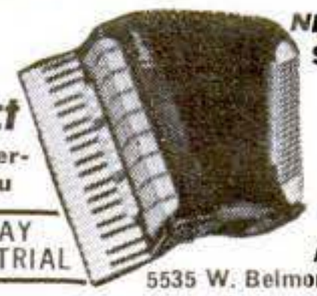

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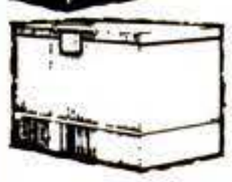

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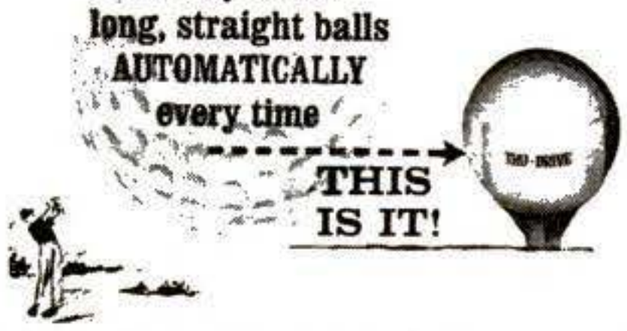

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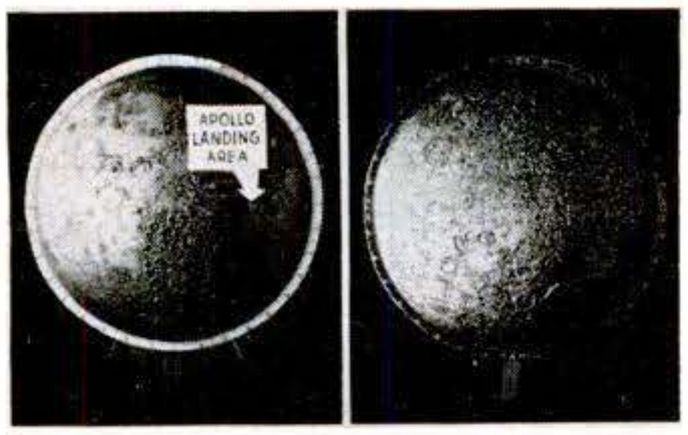

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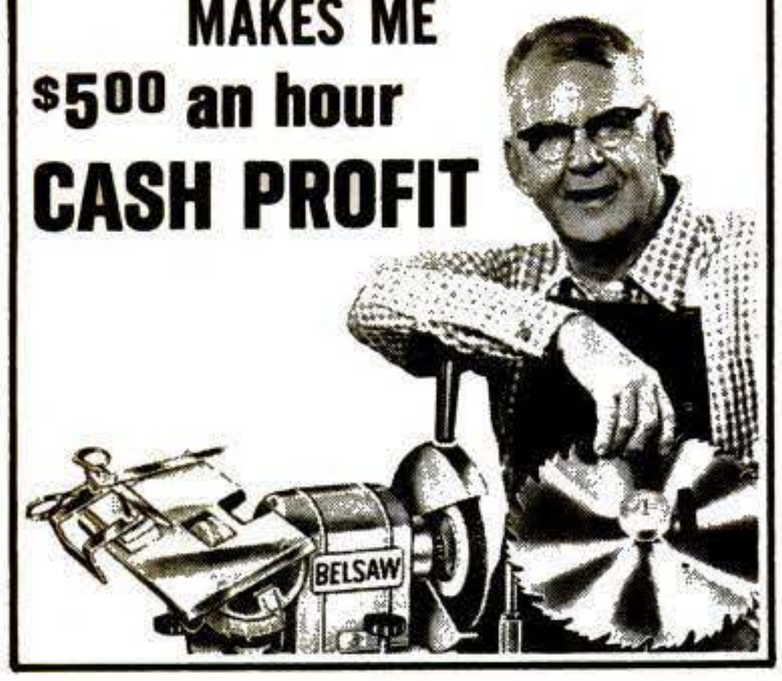

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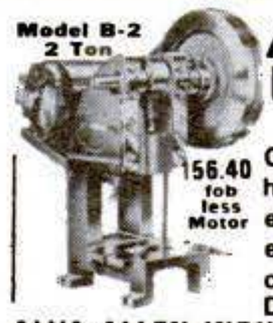

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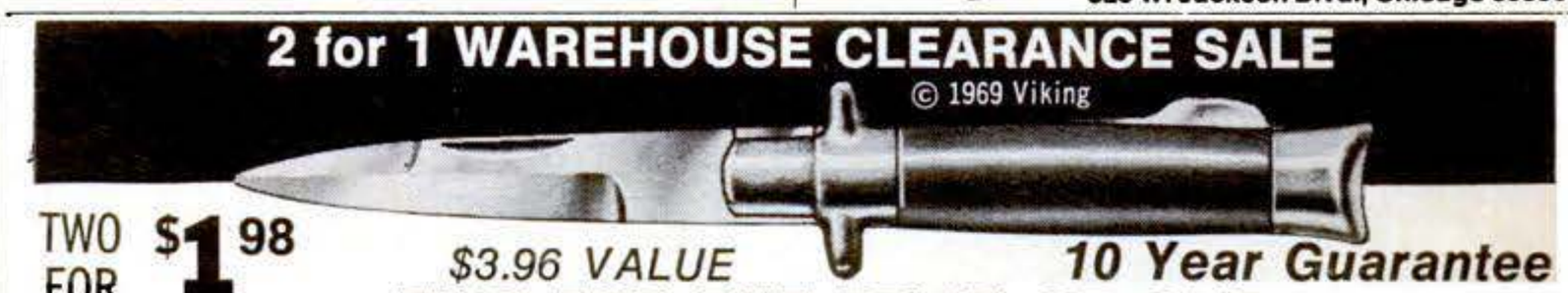

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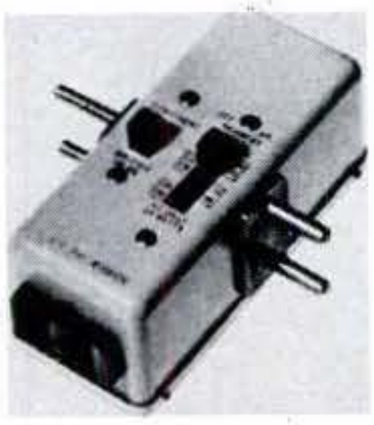

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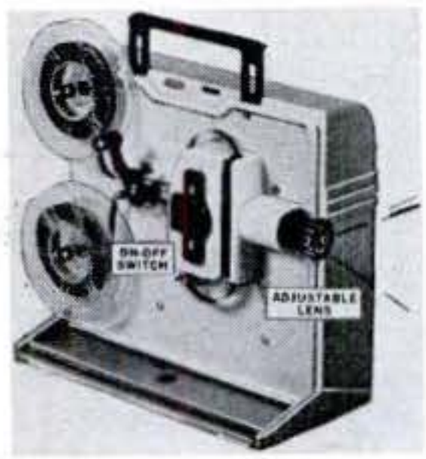

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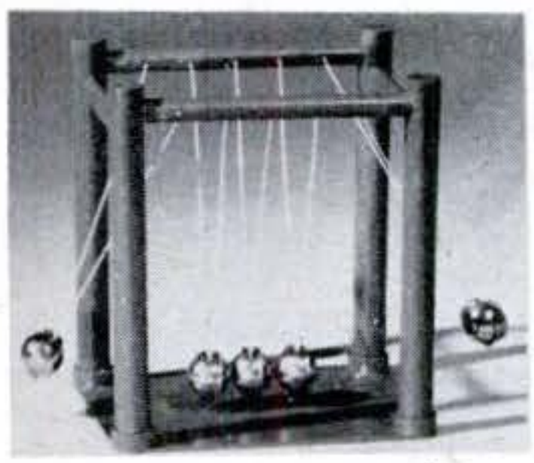

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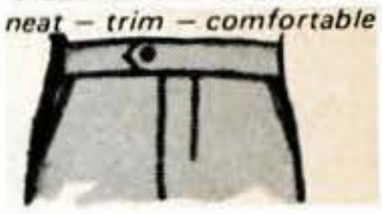

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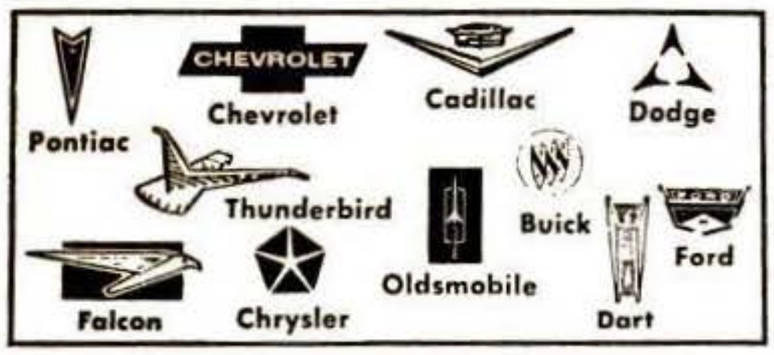

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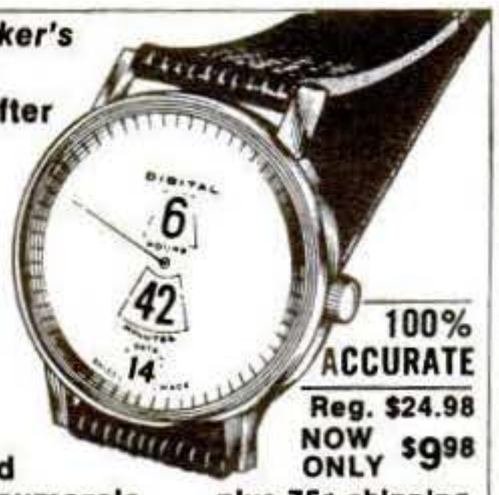

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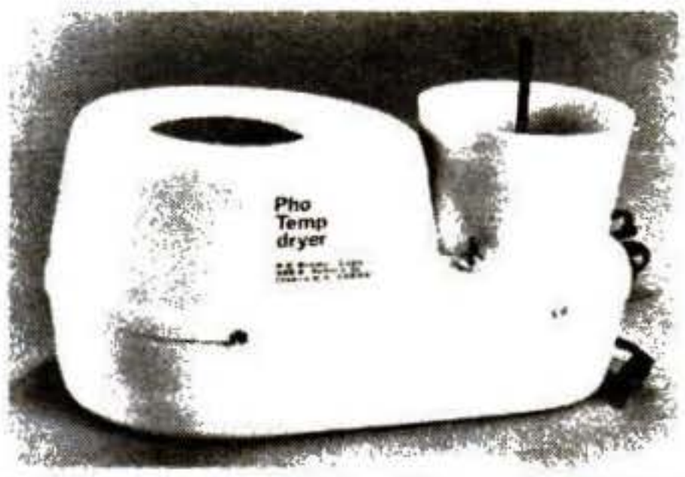

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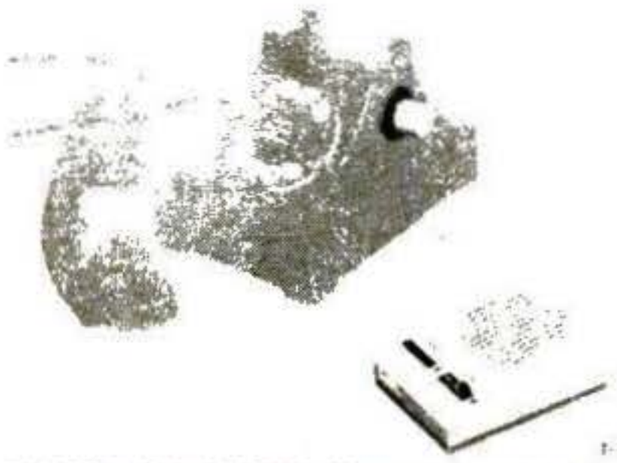

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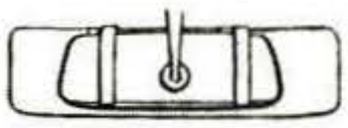

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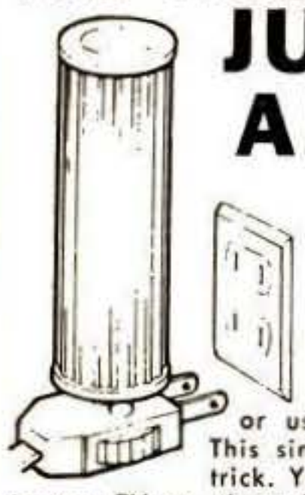

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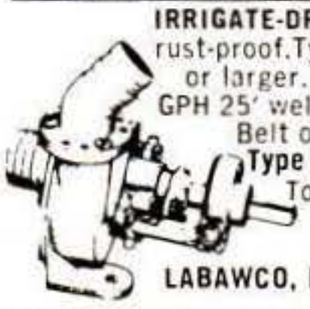

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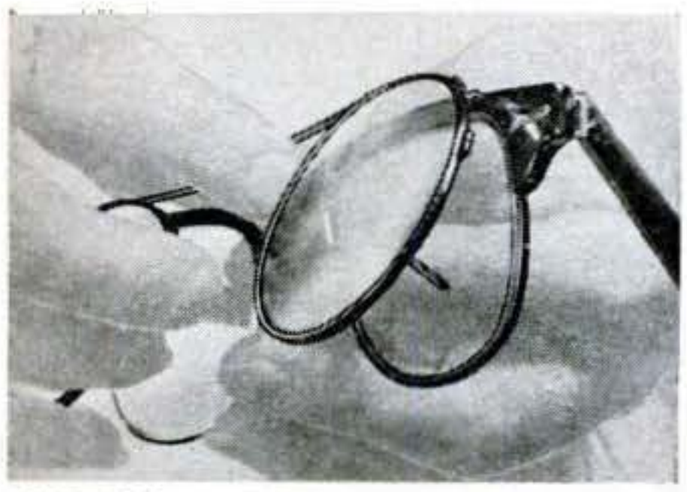

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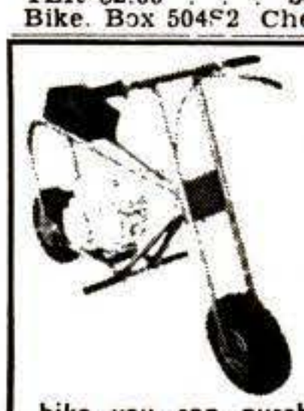

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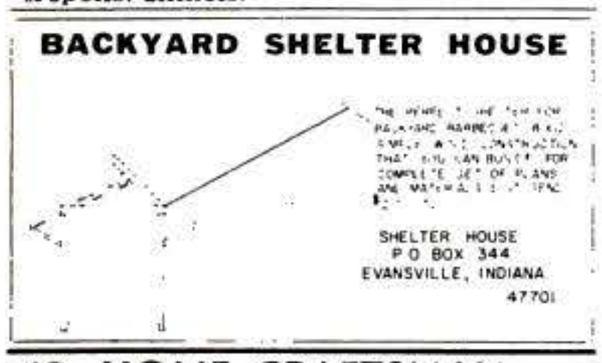

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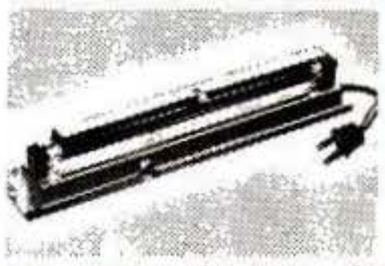

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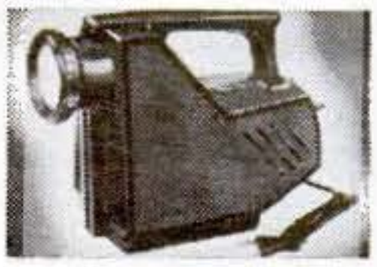

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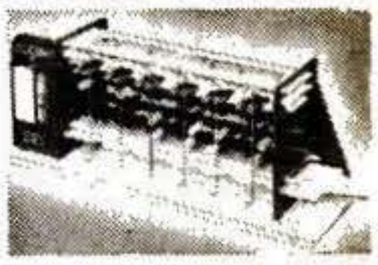

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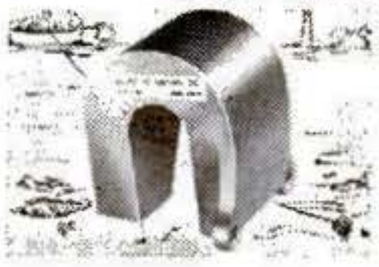

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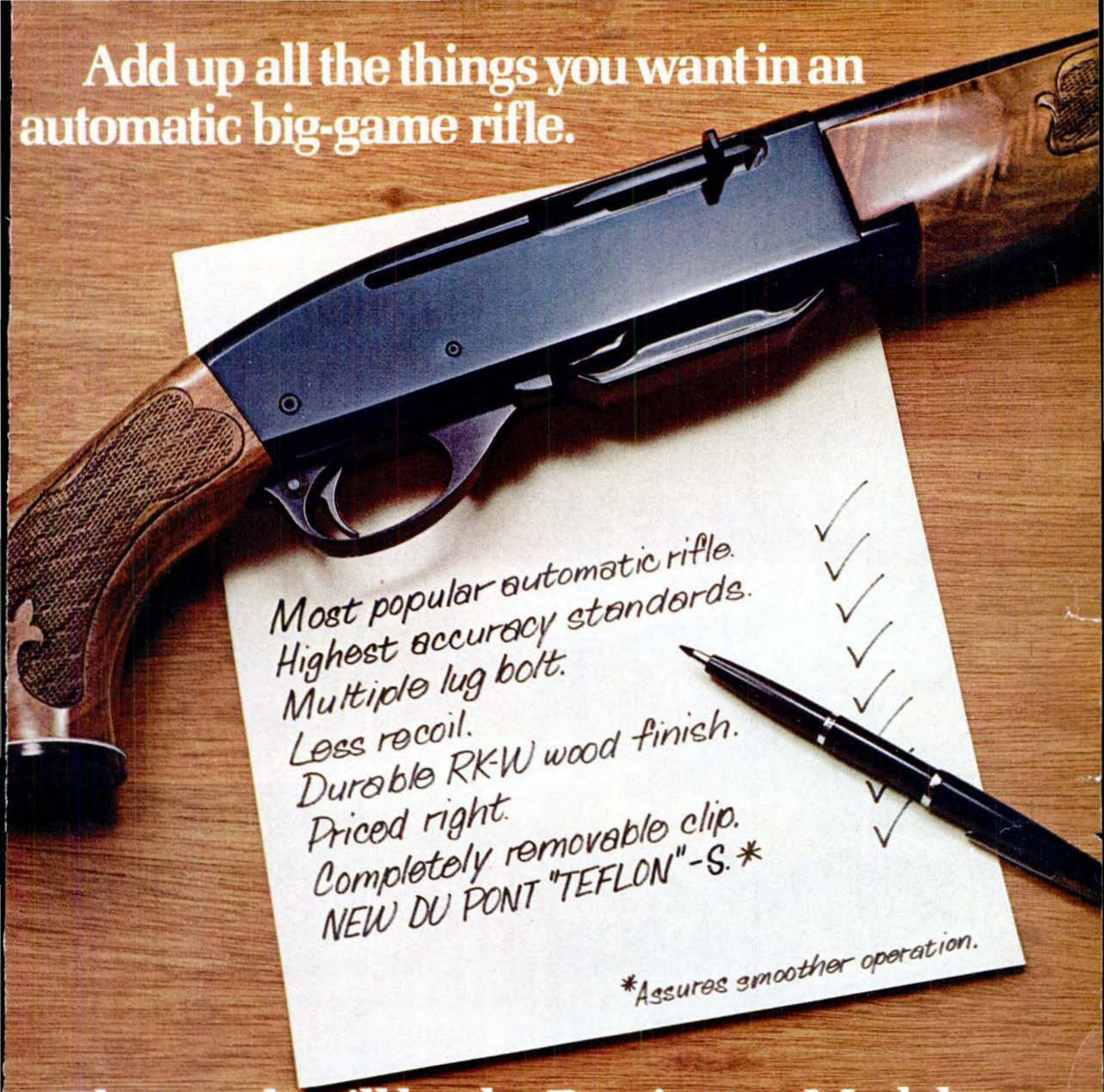

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